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No. 564

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ALBANIA

WORK OF HYDROMETEOROLOGICAL INSTITUTE DISCUSSED

Tirana BASHKIMI in Albanian 17 Apr 77 p 3

[Article by Myzejen Borici: "Hydrometeorological Studies in the Service of Our Economy and Culture"]

[Text] The collective of the Hydrometeorological Institute of the Academy of Sciences of the RPS [People's Socialist Republic] of Albania, guided by its basic party organization, has undertaken to implement the programmatic tasks set forth by the Seventh Congress of the PPSH [Albanian Workers Party], devoting primary attention to the problem of relating science to life and to social production.

At the present stage of our development, following the scientific work, "The Climate of the RPS of Albania," which was published and placed at the service of the economy and culture, the preparation of another scientific work of great interest in the field of climatology entitled, "Climatic Atlas of the RPSSH [People's Socialist Republic of Albania]," became essential for the climatology sector. This work is one of the major scientific actions of the climatology sector and, along with the other scientific work of the hydrology sector, "The Hydrology of Albania," comprises the most significant action of the institute. Through a better organization of its work, the climatology sector has accomplished a series of scientific research processes, such as the homogenization of atmospheric humidity, the behavior of mean air temperatures of a 45-year period (1931-1975), the building of histograms for determining the mean dates of air temperatures, and so on. Besides the work on the climate atlas, another series of thematic and problemmatic works and studies was accomplished to resolve actual and operational tasks which our economy and culture present, thus responding to the demands of various domestic institutions. Thus, for example, the climatic regimen of Vlore Bay was studied, several climatic reports were drawn up for planning the works of the Sixth Five-Year Plan (1976-1980), manuals were compiled on temperature and humidity for years past, and are of assistance to various specialists in the construction, agricultural and industrial fields.

Interesting work was done on the physics of the atmosphere, this being a new scientific research activity for the institute. Measurements of solar radiation were also made. A study was likewise conducted on the possible solar radiation on the plain of Tirana. Work has been and is being done on a guide to atmospheric radioactivity, as well as on methods of determining soil moisture.

The hydrology sector has faced a series of tasks of importance to the national economy and culture. In the field of studies of a broad scientific research nature, work has been and is being done on the work entitled, "The Hydrology of Albania." Within the framework of this theme, several aspects of our country's hydrology and hydrography, which had not been treated previously, were resolved. This sector has devoted attention to the evaluation of the hydrologic regimen of the Lake Prespa--Ohrid--Drin River--Lake Shkoder and Buna River water complex. From the hydrologic point of view, this is considered to be the most complicated water system in our country. For this water complex, data has been compiled on such climatic elements as precipitation, air temperature and so on, and work continues on several others. At the same time, a good part of the construction of aquaduct curbing is done and the daily flow at the main hydrometric control points on the Drin River has been derived.

Of great value to our country's economy are such works and studies as the processing and homogenization of the material of seacoast measurements, such as, for example, the level of flow of water, conducted in the coastal zone. In the water regimens of the basins we are studying, our specialists have relied on the evaluation of relationships which exist with the major geophysical characteristics of the territory. Statistical methods have been used widely for this purpose, while at the same time having genetical methods in consideration. In order to be of service to our economy, work has been done to derive the morphometrical characteristics of the Erzen and the Ishmi river basins, the hydrochemical regimen of the Drin River has been completed, and studies have been made of wave refraction on our country's seacoast.

The hydrology sector has faced quite a few operational tasks, drafting hydrological reports for the projects of the Sixth Five-Year Plan (1976-1980), studying the hydrological and climatical regimen of the Uje e Ftohte zone in Vlore, determining the maximal wave elements in the Port of Durres and in Vlore Bay, studying the general evaporation in the territory of our country, and so on.

In the field of agricultural meteorology, an activity is developing in assistance to the development of our agriculture. A number of scientific themes have been studied in this field, such as "The Phytoclimate of Hybrid Corn," "The Agroclimatic Manual" and the study of the "Determination of the Bioclimatogram of the Cotton Boll Weevil" for the Lushnje-Fier zone, and so on. Experiments of value to agriculture have likewise been conducted, such as the production of young plants through the use of the artificial

microclimate of the hothouse. This experiment has been put into wide scale production at the agricultural cooperative of Nikle in Kruje District. The production of plants in hothouses is an experience with definite technical and organizational superiority and is of great economic advantage. It is accomplished through a new modern technology whereby the thermal, hydric and atmospheric conditions are produced by means of an automatic apparatus produced by our own forces. The sector has scheduled for this year the study of the microclimatic conditions of the Borsh--Fterre--Corraj zone in order to determine the zones for raising plants in hothouses. The experiment to be conducted there is entitled, "Determination of the nighttime temperature suited to the requirements of the tomato plant cultivated with central heating." Likewise, a locally produced apparatus which will record signals of high and low temperatures from various distances will be tested. The signals will serve for taking measures to prevent crop damage.

The Hydrometeorological Institute, carrying out the teachings of the party and of Comrade Enver Hoxha, has devoted great attention to the involvement of the masses in science. It has activated and is activating more and more workers, especially in the field of agriculture, teaching cadres and various specialists for providing data and for the various experiments. For the future, work is being done to further intensify this effort to conduct meteorological and hydrological expeditions with outside collaborators regarding certain problems and issues and in processing the data obtained from these expeditions.

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RESEARCH AND DEVELOPMENT AS REFLECTED BY 1975 STATISTICS

Budapest TUDOMANYSZERVEZESI TAJEKOZTATO in Hungarian Vol 18 No 3-4, 1977 pp 281-315

[Article by Dr Vince Grolmusz, senior staff scientist, Science Administration Group, Hungarian Academy of Sciences]

[Text] Overall Picture of the Growth of the Domestic Research and Development (R&D) Base During the Fourth Five-Year Plan Period - Development Is Still Primarily Extensive - Fifty Percent More R&D Institutions? - R&D Investment Doubled From the Level of the Third Five-Year Plan Period, While the Actual R&D Volume Deecreased During the Five Years - Positive and Negative Development Trends Existed - Did the R&D Activity Become More Effective? - The Ratios According to the Modernized Science Branch Classification System - The Group of Social Sciences Grew Faster Than the Rest - Comparison With Governmental Science Policy Guidelines - Main Trends of R&D Statistics Development.

The Central Statistics Bureau issued a bulletin [1] in February 1977 about the major statistical data concerning research and development in Hungary during 1975.

The bulletin presents the most important data for 1975 and discusses the growth of the R&D base during the five years before (it also compares the 1975 data with the 1974 data, and in some instances also makes comparisons between the Third and Fourth Five-Year Plan periods). On the basis of the bulletin, we describe and discuss the major statistical data in the following classification:

I. Development of the R&D base (1971 to 1975)
II. Weight and role of R&D in the national economy
III. Structure of the R&D base and activity in 1975.

In some instances, we supplemented the data of the KSH [Central Statistics Bureau] with out own calculations (for example where we dealt with the so-called cleaned-up expenditure values, and so forth).

Development of the R&D Base (1971-1975)

The Number of R&D Institutions and the Comparability Problem

The number of domestic R&D institutions grew to 1-1/2 times of the starting level during the Fourth Five-Year Plan period:

Establishment type	1970	1971	1972	1973	1974	1975
R&D institutes	131	129	129	130	130	128
University departments	737	891	1004	1052	1085	1080
Other institutions	203	208	259	261	268	270
enterprises in the above	159	163	187	189	191	189
design bureaus in above	8	8	10	10	10	10
others in the above	36	37	62	62	67	71
Total	1071	1227	1392	1443	1483	1478

Whereas during the preceding (Third) Five-Year plan period the number of R&D establishments increased only minimally, there is now a remarkable increase. As we can see, the numerical increase involved primarily the university departments and the so-called other institutions. However, in this group — as we have already pointed out earlier [2] — more and more new institutions became included in the reporting system, and these broaden the volume of R&D capability (but not always realistically, since they usually represent a much lesser R&D capability). This is confirmed by the R&D work percentage decrease during last year's full reporting period in the minor institutions:

	1970	1975
Average for university department workers	39%	35%
Faculty in above	25%	22%
Educational assistents in above	35%	33%
Average for other R&D institution workers	75%	70%
Graduate staff in above	74%	68%
Assistant staff in above	75%	72%

The attempt of the institutions and the supervisory organs to become included in the R&D base unnecessarily dilutes the institutional R&D network. The present situation that developed from this

- may be regarded as a positive development since we now have a more complete picture about the R&D activities since we include the institutions which perform R&D on a relatively small scale. Thus, our picture reflects more accurately the increasing social role of R&D, its increasing institutionalization, and its increased social significance;

- may be regarded as a negative development since we now include among the R&D institutions those which perhaps should not be included or do not yet qualify for inclusion because they are still in the beginning stage, and that as a result we obtain the wrong impression of a very fast rate of growth of our R&D base. We merely increase our statistical problems.

In order to resolve this contradiction, it would be desirable to define more accurately the most important criteria of a R&D establishment and to use this definition in the statistical work in a consistent manner, so that establishments are included only if they are beyond a certain preliminary stage of their development.

The problem of the comparability of statistical data pertaining to different years arises in our case as a result of changes in the observed facilities in terms of numbers and activities. The corrections made to deal with this factor do not affect those problems of comparability — in our judgment — which are of paramount importance as they result from major changes in the labor-related, financial, and similar data as they are compiled.*

* For example, during the five-year period examined, the new research institution job classifications introduced more or less changed the ratios of scientific workers, auxiliary scientific workers, and other employees, and thus also altered the meaning of the indicators. Thus, for the research establishments operating under the jurisdiction of the Eu.M. [Ministry of Health] the meaning of the investment and staff data changed because of the 1973 establishment of the so-called research cost allocation system; in the university departments the investment indicators include more factors since 1974; and in all institutions the reported figure about invention now means something else than it did at the beginning. There are other examples also. Although the KSH publications list these changes, they do not provide updated figures for earlier years, recalculated to permit year-to-year comparison. These problems therefore indeed make comparison difficult or even entirely impossible.

The purposes of comparison are served by those percentage indicators in the KSH statistics which were computed without including the changes made necessary by new regulations.*

Considering the specific conditions prevailing during the period investigated, we are justified in asking the following question: which indicator is better suited for the proper evaluation of the development of the R&D base, the original or the new?

Before suggesting an answer to this question, let us discuss the differences between the information provided by the two kinds of indicators in a specific fashion.

According to our calculations, there is a relatively significant difference between the results of the two calculations insofar as the staff size changes are concerned. On the other hand, the differences are quite insignificant insofar as the changes in investment expenditures are concerned.

	According to the original data of the entire observational material	Calculated without the new reportings
Actual change in staff during five years	+26.2%	+18.9%
Reduced staff change (on the basis of equivalency values)	+19.1%	(no data available)
Actual researcher staff changes in five years	+46.8%	+27.5%
Reduced researcher staff change in five years	+38.7%	(no data available)
Changes in R&D expenditures in five years	+70.4%	+68.3%

* In characterizing the year-to-year changes, the KSH publication usually only reports this kind of "comparable" percentage indicators since 1970. It should be noted, however, that it also publishes the full data for the observed features to permit the computation of the uncorrected basic indexes and chain indexes also.

Because of the only insignificant differences, the preparation of such comparability indexes is not necessary and thus may be dispensed with. But in the case of the staff indicators it would be necessary to calculate the indexes for the reduced staff sizes since only these would permit meaningful comparisons. If we do not have the latter, only the indexes of the reduced staff sizes calculated from the original data of the entire observational volume can be regarded as truly comparable.*

Below we discuss primarily the data pertaining to the observational volume actually covered. However, if judged useful — primarily in connection with staff-size data — we will also present the corrected change indexes calculated with disregarding the new reporting sites.

Regional Distribution

Among the R&D establishments observed, there was a reduction in the number of those located in the capital city, both in terms of the number of the establishments and of the size of the staffs.

Indicator	Year	In Budapest	In the provinces	Total
Number of R&D establishments	1970	54%	46%	100%
	1975	51%	49%	100%
Number of workers	1970	77%	23%	100%
	1975	72%	28%	100%
Number of researchers	1970	75%	25%	100%
	1975	71%	29%	100%

* This is also confirmed by the fact that the expansion of the observational volume during the five-year period investigated indeed reflects the establishment of new institutions and therefore the expansion of the R&D network, in spite of the fact that the new reporting locations are not yet full-fledged R&D establishments. For this reason, it would be better in the future to give not corrections but to stabilize the observational network for a period of several years, for example for five years.

In general, these changes do not indicate that existing R&D facilities have moved to the provinces. They do indicate the fact that as the number of reporting locations increases, the increase is represented primarily be the inclusion of more provincial establishments.

It should also be added that the above data indicate that the intellectual base of the R&D operations is still excessively concentrated in the capital.

It is mentioned here that the KSH publications issued since 1974 have removed from the "provincial" R&D establishments those located in university towns (Debrecen, Miskolc, Pecs, Szeged, Veszprem, Sopron, Keszthely, and Godollo). Their percentage in 1975 was 31. They include a total of 454 establishments, including 14 R&D establishments, 426 university departments, and 15 other R&D facilities.

Staff Changes

The actual number of people employed in all reporting R&D establishments increased from 64,420 in 1970 to 81,290 by the end of 1975. Thus, the increase was 16,870 (26 percent). This represents an annual increase of 4.7 percent on the average.

The table on the next [translation] page shows the change in the reduced staff changes based on the equivalency data, which provide a truer picture of the R&D capacity.

On the basis of the reduced data, the number of employees increased by 19 percent in five years, representing an annual increase of 3.5 percent on the average, while the number of researchers increased by 38.7 percent, representing an annual increase of 6.8 percent on the average.

According to the KSH report, from the 16,9000 staff increase in five years

12,900 (76 percent) represented an increase in the number of workers from the original base, and

4,000 (24 percent) represented an increase resulting from an increase in the number of locations reporting.

(For the researchers, these figures are 7,600 individuals - 68 percent, and 3,500 - 32 percent, respectively.)

in 1000 individuals

Index	Actual staff size 1970	Actual staff size 1975	Reduced staff size 1970	Reduced staff size 1975
Total workers	64.4	81.3	50.7	60.4
researchers in above	23.7	34.8	16.3	22.6
helpers in above	29.2	34.2	23.8	27.2
clerical and other	11.5	12.3	10.6	10.6

According to corrected data,

the number of employees grew by 3.5 percent;
the number of researchers grew by 5.1 percent

in five years, per year on the average.

The number nationwide of those having advanced degrees increased from 4,300 in 1970 to 5,650 by the end of 1975 (a 30 percent increase). The rate of increase decreased steadily year to year during the last 15 years. According to the KSH publication, the annual increase in the number of those with advanced degrees was the following in the last few five-year periods:

+7.8 percent between 1961 and 1965;
+7.1 percent between 1966 and 1970;
+5.6 percent between 1971 and 1975.

According to the type of advanced degree, the rate of increase decreased most among those with a candidate's degree (the annual average between 1971 and 1975 was 5.2 percent).

The number of those performing institutionalized aspirancy decreased nationwide from 590 individuals in 1970 to 370 individuals by the end of 1975 (a decrease of 37 percent).

During the five-year period examined, the percentage of those with an advanced degree working in the reporting R&D establishments decreased, and the number of those working in other places, as well as that of the retired persons, increased. The number of those with an advanced degree working in the reporting R&D establishments increased on an absolute scale: there were 3,070 in 1970 and 3,870 by the end of 1975 (an increase of 26 percent, representing an average annual increase of 4.7 percent). But their percentage among all researchers decreased in five years from 13.1 percent to 11.5 percent.

In the reporting R&D establishments,

the number of academicians employed decreased by 1 percent;
the number of doctors of sciences employed decreased by 43 percent;
the number of candidates of sciences employed decreased by 25 percent

during the 1971-1975 period.

The percentage of women among the researchers increased from 22 percent in 1970 to 26 percent by the end of 1975. Their percentage in university departments was higher than the national average. During the five-year period examined, there were 12 percent women among those on their way to an advanced degree and 19 percent women among those accepted for aspirancy. To these data we may add that the women managers were larger in number in the R&D establishments in the end of 1975 (188 women) than in 1970 (92 women); their number increased from 5 percent in 1970 to 7 percent by the end of 1975.

The researcher-to-assistant ratio deteriorated nationwide and each type of establishment. On the basis of equivalent data, the average number of assistants per 100 researcher decreased from 148 in 1970 to 121 by the end of 1975. Within this average, the decrease was
from 132 to 110 in the R&D institutes;
from 65 to 59 in university departments;
from 215 to 169 in other R&D establishments.

The deterioration of the researcher-to-assistant ratio was due to a variety of factors, such as the decrease in the labor supply, the increased attraction of other employment, and deficiencies in personnel policy.

There was also nationwide a deterioration in the supply or other aides (such as administrative employees, typists, clerks, and so forth): per 100 researchers — based on reduced numbers — the number decreased in five years from 212 in 1970 to 167 by the end of 1975. (The corresponding decrease in the R&D establishments proper was from 255 to 198.)

Expenditures

The expenditures for R&D institutions were 28.1 billion forints during the Third Five-Year Plan period, and 55.8 billion forints during the Fourth Five-Year Plan period. This means that there was a 27.7 billion forints increase (corresponding to an increase of 99 percent).

A comparison of the average annual expenditures — and within this the operating and investment expenditures separately — during these five-year periods shows the following pattern:

Index	Average annual sum 1966-1970	1971-1975	Increase in %
Operating costs in billion forints	4.60	9.10	+ 97.8
Investment costs in billion forints /+/	1.02	2.06	+102.0
Total expenditures	5.62	11.6	+ 98.6

At the same time, the average annual growth rate of the expenditures decreased during the two five-year periods: from 14.6 percent for the Third Five-Year Plan period to 12.7 percent for the Fourth Five-Year Plan period.

From the total expenditure of 55.8 billion for the Fourth Five-Year Plan period, 52.2 billion (93.5 percent) was expended for the R&D establishments examined in the statistical study. According to our calculations, approximately 0.5 billion of this sum was expended for the newly reporting establishments.

The following are evident from the annual data: The total nationwide expenditure for the R&D establishments was 7.7 billion forints in 1970 and 13.9 billion forints in 1975; this represents a 80,5 percent increase, and an annual growth rate of 12.5 percent on the average.

The sum expended for actual R&D nationwide increased from an annual amount of 6.58 billion forints to 11.41 billion forints in 1975; this represents an increase of 73.5 percent in five years and an average annual growth rate of 12.5 percent.*

The expenditures changed in the following manner during five years according to sources of financing:

* This indicator, which was not cleaned up from non R&D expenditures, was considered on the basis of data from the KSH; outside the reporting establishments we estimated it on the basis of the same ratios. We described the method of our interpretation and calculation in TUDOMANYSZERVEZESI TAJEKOZTATO, No 3-4, 1976 pp 308 and 314.

Source	Percentage distribution in 1970	in 1975
Technical development fund	65.4	68.3
State budget	32.5	28.6
Enterprise profits	2.1	3.1
Other	0.0	0.0
Total	100.0	100.0

It can be seen from the foregoing data that among the sources of financing the contribution of the technical development fund and the enterprise profits increased, and the contribution of the state budget decreased during the five-year period. The percentage coming from the state budget continues to decline from the level of 1/3 which was considered desirable according to the National Long-Range Scientific Research Plan. The "other" sources refer to such sources during the five-year period as ministry-controlled funds coming from withheld portions of contract work income or foreign research supports (granted by foreign bodies). The percentage of these sources, however, never exceeded 0.1 percent.

The expenditures were divided in the following manner according to type of disbursement during the five-year period:

- On the basis of data summed up for the five years: 82 percent for operating costs and 18 percent for investment costs (the same ratio as in the Third Five-Year Plan period);

- The total operating costs nationwide were 6.0 billion forints per year in 1970 and 11.5 billion forints in 1975; this represents a 91.7 percent increase in five years, corresponding to an annual growth rate of 13.9 percent; the investment costs were distributed very non-uniformly among the years of the five-year period: there was a low in 1972-1973 and a peak period in 1974-1975 (2.4 billion forints per year, representing the highest annual level ever).

The following factors affected significantly the changes in the real value of these expenditures during the five-year period examined: the wage increases per worker (especially the wage readjustment performed in 1974), and more-than-average price increases for materials, supplies, power, and investment goods. Unfortunately, the KSH bulletin does not quote data about this; however, we have indirect means for estimating it from some indexes and data from some typical studies carried out during the first few years of the five-year period.

According to our calculations, the real value of the nationwide expenditures of the reporting and non-reporting R&D establishments (and the actual expenditures) were the following during the Fourth Five-Year Plan period:

	Real-value increase in five years	Same in annual averages
Total expenditure	+2.8%	+0.5%
Operating costs in above	+7.5%	+1.5%
Investment costs in above	-13.7%	-3.0%
R&D expenditures in above	-1.2%	-0.2%

Accordingly, in spite of the apparently high rate of increases in the material and financial support, there was no significant change in the material and financial support insofar as the total expenditures were concerned. As a matter of fact there was only a minuscule increase, whereas the actual R&D expenditures declined in a very slight degree.*

* For the information of the reader we mention the fact that in our calculations we obtained the following values for the yearly average price increases:

  +12.2 percent for the operating costs;
  + 5.0 percent for the investment costs;
  +12.5 percent for the total expenditures.

  These values are more likely to be lower than the values so far found in representative studies. Therefore, our data may be considered as being cautious estimates.

  Since the systematic calculations of this kind are also justified by the science policy guidelines of the government and the party (for example one must ensure that the extent of the research activities should not decline as a result of changes in prices), it would be desirable to include basic data about these matters in the annual data-collection program of the KSH.

The utilization of the expenditures according to types of activity was as follows:

Activity	Increase in expenditures In five years	Annual average
Actual R&D work	+ 74%	+11.7%
Scientific services	+146%	+19.7%
Experimental production	+122%	+17.3%
Other (welfare, cultural)	+124%	+17.5%

According to these indexes, the basically passive process of the amalgamation of proper R&D work and other related work accelerated in our R&D establishments during the period investigated. It is therefore evident that the intellectual and technological capacity concentrated in these establishments is more versatilely utilized as time goes on. In our experience, the so-called related activities (such as scientific services and experimental production) have a more powerful incentive than actual R&D work. We may therefore be concerned that this amalgamation may eventually distort the desirable ratios of these efforts, meaning that we may pass beyond a reasonable limit and will adversely affect our total performance. The fact that the percentage of actual R&D work was no more than 82 percent in 1975 based on the total expenditures already justifies the development of the already mentioned cleaned-up expenditure indexes. At this ratio, the total expenditures of the R&D establishments cannot possible called R&D expenditures!

According to forms of financing the KSH bulletin does not provide breakdowns; however, it provides sufficient data for us to calculate this. The following were calculated for the ratio of the two major financing forms in the utilization of the funds by the reporting R&D establishments:

	1970	1975
Percentage of expenditures for institution financing	59%	51%
Percentage of expenditures for project financing	41%	49%
Total	100%	100%

A detailed analysis of the data available tells us that the percentage of project financing from central sources increased within the sums obtained for project financing overall. The role of the centralized technical development fund increased particularly (this fund is managed by the OMFB [National Technical Development Committee] and the ministries).

In the project-financing system, the R&D establishments become the beneficiaries of price income when they perform contract work. This is a means of obtaining income. The KSH publication reports only the profit data of the major R&D establishments. According to these data, the establishments realized a gross income of more than 4.3 billion forints in the five years; the annual sum almost doubled during the period. The profit was divided in a $\frac{2}{3}$:$\frac{1}{3}$ ratio between the establishments operating on an enterprise and budget basis, respectively.

After the various profit levies, approximately 66 percent remained with the establishments from the gross profits; an institutional fund amounting to approximately 2.9 billion forints was established from this: a sum of 0.9 billion forints as a so-called participation fund and a sum of more than 2.0 billion forints as a so-called development fund. The former increased in five years to about 1-1/2 of the original amount; the latter increased to more than twice the original amount.

The sole source of profit in R&D establishments managed as an enterprise, and a secondary source of profit in other establishments, is that arising from studies made by self initiative; these studies usually meant the preparation of subsequent contract work for profit. The increase in profits is significant if we consider this factor. Unfortunately, however, a change in the economic regulators caused a reduction in the research work started by self initiative in the last years of the period examined.

Changes in the R&D Activities

We wish to stress the fact that our statistics — same as those in other countries — provide no indicators for analyzing the changes in the R&D work performance. The changes can be expressed only by estimation from various points of view, using orientation data and indexes.

The data summed up for the five years essentially indicate the scientific, publishing, innovating, and inventive activities of the researchers of the reporting establishments for the years 1971-1975:*

Number of successfully completed projects:	68,270
Number of books published:	5,230
Number of articles published:	76,380
Number of innovations reported:	25,210
Number of patents applied for:	7,460

On the basis of the reduced staff sizes, there was a gradual decrease in the number of themes per researcher during the period examined. This is not the result of some rational concentration; it is merely due to the fact that the number of researchers grew slower than did the number of themes. But it is worthy of note that the average running-through time of a theme (based on the total themes being worked on and the number of completed themes) changed in these five years; in 1970 it was 1.77 years and in 1975 it was 1.94 years. The maximum of this index was reached in 1972, when it was 2.02 years. Since then, there was a gradual decrease, and it was 1.90 in 1975. This process was significantly affected by the fact that the OTTKT [National Long-Range Scientific Research Plan] was developed and promulgated in 1972, so that there was a "theme switching" thereafter, and that the percentage of relatively shorter projects increased as there were more and more contractual projects. Although these major factors tended to reduce this index, its increase to a higher level than before could not be prevented. This means that there was a net increase in the average running-through time of the projects.

The data quoted below permit some conclusions to be reached about the effectiveness of the R&D work performed:

- Among the completed themes, 91 percent was successfully completed in the five-year period. Nine percent was unsuccessfully completed. The percentage of the latter shows a slowly increasing trend from year to year.

* Since these data usually show a considerably variability from one year to another in the period examined (an increase was followed by a decrease and then by an increase once again), we could not merely compare the 1970 data with the 1975 data. Instead, we try and indicate the changes by showing some major trends.

- Among the projects completed successfully, 53 percent were introduced into practice over the five-year period; this index also shows a decreasing trend (from 68 percent in 1971 to 47 percent in 1975).*

- On the average from every 100 reported innovations 43 were actually implemented (based on data for four years).

- Sixty-two percent of all patents applied for by researchers in the reporting establishments were also applied for abroad (in this connection, each country was regarded as a separate application).

- There were 73 patents granted from every 100 patents applied for domestically (based on data for four years).

- There were 59 foreign patents granted for every 100 patents applied for abroad (based on data for four years).

A more detailed analysis of these indexes indicates that the effectiveness of the work of the researchers in the reporting R&D establishments gradually decreased on a national average. Presumably part of the reason for this was that the researcher-to-assistant ratio deteriorated, that the expenditure volume stagnated, that the development continued in an extensive fashion, that our research management system is deficient in many ways, and so forth. Only through examining the causes in detail can we establish the factors responsible for the deterioration of the effectiveness and establish the major measures required for the rectification of the situation.

Our international relations continued to broaden and deepen during the five-year period examined. The number of themes handled under international cooperation increased 1-1/2 fold during the five years; now one out of 18 is such a project. The international cooperation of university departments grew more than average. The number of scientific trips made by our researchers increased by approximately 33 percent in five years, and now about one-third of the researchers go abroad (according to the KSH report, every third researcher, on the average, went abroad; however, in reality this is not so since the same persons tend to go several times per year. But this is not evident from the data given). There was practically no change in this respect insofar as the relations and the trip lengths are concerned; the percentage of trips lasting more than one month is minimal still.

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* Since the statistical report always relates the number of new themes to the sum of the themes for last year and those successfully completed during the given year, we took the arithmetic average of these two as 100 percent in our calculations.

Growth of the Research Base in University Departments

The science policy guidelines of the government and the party judged that an above-average growth rate of the research base in university departments is desirable. There are two main reasons for this:

1. After the liberation, the primary trend was the development of the major research-development center network and the fast expansion of the reconstructed institutional research base; the university departments as R&D establishments were given less attention. As a matter of fact, the primary trend drew forces away from the university departments and also from the enterprises. It therefore became necessary to bring the university departments in line once again.

2. In spite of the slower rate of growth, an increasing intellectual capacity was established in the university departments, and this could not be fully utilized by teaching functions alone. The excess intellectual capacity — which is particularly well suited for carrying out complex interdisciplinary studies — could be included in the R&D program fully with proper funding and staffing.

Although the data for the various institution types, calculated by quite different methods, do not permit accurate comparisons, the indexes indicating the changes clearly demonstrate the fact that the research base in university departments does indeed grow faster than average (the only exception is the corrected KSH staff-size index). For example, the average spending per researcher (full-time) increased 1.6-fold in five years at the university R&D establishments, while the corresponding figure was 1.2 or so in the various other R&D institutions.*

* The significance of this growth rate difference becomes even greater as a result of the fact that the statistical report considers fewer cost factors in university expenditures than in other institutions (basically, it only considers the cost factors actually related to R&D work). In recent years, several attempts were made to bring the cost calculations for university departments closer to those in other R&D establishments. But these attempts tried to reach the desired goal through estimations nationwide, using a uniform scale (for example, the professors' salary was 1/3-allocated for research, and the other costs on the basis of similar factors), and met with mixed reactions among those concerned. The estimation methods are less and less favored these days, mainly for the reason that such fictitious cost factors develop a major importance
[footnote continued on next translation page]

However, in assessing the relatively high growth rate we must take into consideration the fact that this relatively fast growth started from a relatively small base in the case of the university departments. If we calculate the sum of average expenditure per year for an institution on the basis of data for major institutions (28.9 million forints in 1970 and 54.2 million forints in 1975) and divide the sum of the annual expenditures for university departments and other R&D establishments by this sum, then we find out the number of average establishments that could have been funded from the sum spent on the latter:

	1970	1975
University departments	19	24
Other establishments	109	84

This represents the equivalency figures. It can be seen that the present 1,080 university-department research institutions equal no more than 24 institutions on the expenditure basis! But even the funding of the other types of R&D establishments is below that of the major research institutions. We must therefore make up quite a gap in the development of the research facilities of the university departments if our real goal is to make them equals of the institutions in terms of material and financial support.*

*[see footnote on next translation page]

Growth of the Social Science Base

According to the science-policy guidelines, it is desirable to increase the rate of growth of the social science base faster than that of other sciences.

[footnote continued from preceding translation page]
in the evaluation of the material and financial support of the research function of the university departments, whereas in reality the research leaders of the university departments lack such material and financial funding, and even if they do, these do not affect the cost factors insofar as research policy is concerned. It is indeed true that the volume of material and financial funds capable of being mobilized for local research policy is always lower than one would estimate on the basis of the statistical data. But all this could never reduce the importance of the role of the various estimations in the future for cost forecasting since these have other uses and goals.

As we all know, this became necessary for the following main reasons:

- There were no legal possibilities in Hungary before liberation for pursuing Marxist social sciences; thus the institutional basis for such studies had to be established and developed after liberation;

- Dogmatism provided a great setback for this branch of science in the 1950's; then the counterrevolution created an ideological chaos which stood in the way of the development of social sciences in Hungary;

- We are particularly behind in such subject areas as sociology, pedagogy, and psychology;

- As our society grows, the needs for social sciences grow also, and we have more and more problems to solve; thus, there is a need for the corresponding growth of the social-scientific research base.

The data for this branch of science in the KSH publication — already prepared on the basis of the modernized branch — show clearly that this goal has indeed been met during the five-year period examined:

The annual increase rate per worker between 1971 and 1975 on the average in terms of expenditure:

11.7 percent for the social-sciences base;
10.7 percent for the natural-sciences base;
9.3 percent for the medical-sciences base;
7.9 percent for the technical-sciences base;
3.8 percent for the agricultural-sciences base.

The greatest excess above the national average of 7.8 percent was in the field of social sciences.

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*[footnote from preceding translation page]
In connection with the science-policy guidelines mentioned earlier some people ask the time for which such preferential treatment will ge given to the university departments. In our opinion, this depends on the aimed-for ratio or level of development. But this has not been decided yet. If we think that the approach we propose (which is not full catching up) is realistic — on the basis of today's cost accounting methods) — then there is much time before this question becomes urgent since more than five years would be involved under such conditions.

At the same time, it is interesting to note that within the social sciences this index shows particularly high growth rate in the following branches:

- the so-called other social sciences (such as foreign affairs, labor affairs, trade-union affairs, market research, computer technology, and so forth)	34.5 percent
- art research	25.7 percent
- pedagogic research	25.2 percent
- communications research	13.0 percent

It is interesting that most of these subjects were not even among those earmarked for special development.

THE WEIGHT AND ROLE OF THE R&D BASE IN THE NATIONAL ECONOMY
Indexes Showing the Econonic Weight of the R&D Base
The tabulation on the next [translation] page indicates the changes in the major indicators on the national level.

The data for these current-price macro indexes — except for those with the code 4 and for some declines in certain individual years — all indicate an increase in the economic weight of the R&D base. On the other hand, the macro indexes computed on constant prices, indicate a gradual decrease of this weight!

On the basis of international comparison — realizing that the conditions for a really dependable comparison do not exist — we can conclude the following:

- With an index of 2.3 percent per year for Item 3.3 we reached the level of the United Kingdom for 1969/1970 and the level of the Federal Republic of Germany for 1972; we slightly surpassed The Netherlands, Switzerland, Japan, France, Belgium, and Denmark for the early 1970's — on the basis of corresponding data published in the UNESCO Statistical Yearbook. (Since it is not apparent from this publication where the figures were computed on the basis of constant prices and where they were computed on the basis of current prices, we always made the comparisons with the Hungarian figures computed on the basis of current prices. If we had used constant prices, we would have obtained quite different results, showing the foreign countries more favorably.)

(A) Makromutatók	1970	1971	1972	1973	1974	1975
1. A K+F intézmények dolgozói az ország aktív keresőinek %-ában	1,29	1,41	1,49	1,53	1,59	1,59
2. A K+F intézmények ráfordításai						
2.1 a nemzeti jövedelem %-ában	2,79	2,95	2,97	3,04	3,29	/2,24/[x] 3,46
2.2 a belföldön felhasznált nemzeti jövedelem %-ában	2,68	2,76	3,02	3,18	2,91	/2,27/[x] 3,25
3. A tulajdonképpeni K+F ráfordítások						
3.1 a nemzeti jövedelem %-ában	2,38	2,51	2,45	2,52	2,52	/1,90/[x] 2,84
3.2 a belföldön felhasznált nemzeti jövedelem %-ában	2,29	2,33	2,48	2,64	2,38	/1,93/[x] 2,67
3.3 a bruttó hazai termék /GDP/ %-ában	1,98	2,07	2,03	2,09	2,22	2,34
4 Az állami költségvetésből fedezett kutatási ráfordítások a költségvetési kiadások %-ában	1,42	1,46	1,46	1,39	1,28	1,26
5. A kutatási célu beruházások a népgazdasági beruházások %-ában	1,88	1,90	1,78	1,64	1,96	1,67

Key: 1. Workers in R&D establishments, in percent of all wage earners in the country
2. Expenditures of the R&D establishments
2.1 As percent of the national income
2.2 As percent of the national income utilized domestically
3. Actual R&D expenditures
3.1 As percent of the national income
3.2 As percent of the national income utilized domestically
3.3 As percent of the gross national product (GDP)
4. Research expenditures funded by the state budget as percent of the total budget
5. Research-oriented investments as percent of the total investments
A. Macro indexes
x. The same calculated on constant price basis! These indexes then decreased considerably in five years!

([Note to tabulation on preceding page] See the footnote on the data base earlier for the interpretation of the indexes given under Item 3. The others were quoted on the basis of the KSH publication; in the case of Item 2.2 supplemented with information for 1970-1974. For the latter, the average index is 3.07 on the basis of data for five years, as quoted by the KSH.)

- The R&D expenditures amounted to 2.62 percent of the net national income in 1975; this is still quite below 5 percent for the Soviet Union, 4.3 for Czechoslovakia, and 3 percent for Poland (all for the years 1972-1973, as quoted by the UNESCO Statistical Yearbook).

The relationships between the R&D expenditures and the national income are again receiving great attention in our country. Partly to reflect this emphasis, the law promulgating the Fifth Five-Year Plan already denotes the magnitude of the R&D expenditures as percent of the domestically utilized national income (specifying 3 percent). Accordingly, this index became a plan indicator also. The question also arises: is it advisable for the R&D expenditures to grow at a faster rate as the national income, as the science-policy guidelines still stipulate?

But is makes little sense to ask the question in this fashion. This is not merely a matter of a decision; the root of this relationship is the essence of the financing of the R&D activities in the socialist countries, including Hungary. It is a fact known from experience that industrial production usually grows more dynamically than the national income, that the technical development fund grows basically in proportion to the industrial production — for a given system of establishing this fund — and that therefore the R&D expenditures must grow at a faster rate than the national income since the technical development fund is built up primarily from the proceeds of industrial production. We therefore need not make a special decision to promulgate this.

The situation would be quite different is we were to criticise the relatively fast rate of growth of R&D expenditures by itself. But this can and must be done only in the light of other relevant considerations!

Evaluating the indexes according to the branches of the national economy, we find the following changes in the weight of the assigned R&D base over the five-year period:

Economy branch	Research and development workers as percent of the wage earners		Research and development expenditures as percent of the national income of the economy branch concerned		Research and development investments as percent of the investments	
	1970	1975	1970	1975	1970	1975
Industry	1.84	2.11	3.85	3.70	2.89	2.35
Construction industry	0.58	0.62	0.63	0.82	1.32	2.28
Agriculture, forestry	0.35	0.49	1.72	1.84	0.84	1.03
Transportation and communication	0.17	0.27	0.33	0.64	0.10	0.19
Other (services, residential, health, culturel affairs, administration, etc.)	3.13	3.91	-	-	2.63	2.39
Commerce	0.02	0.02	0.01	0.01	0.00	0.00
Total	1.29	1.59	2.79	3.46	1.88	1.67

Note:

In this tabulation of the KSH, the data of the examined R&D establishments are listed under the economy branch they serve with their activities. In the number of the active wage earners for the branches of the economy, the data for the private sector are included also; in the investment figures, only the data for the socialist sector are included. The row of totals also includes expenditures whoich could not be included in the tabulation separately.

These indexes — except for the expenditure and investment ratios of industry and all ratios of commerce — show a major change, and demonstrate increased weight for the R&D branch bases in the individual branches of the economy! The more recent KSH publications also quote the ratio of researchers as a percentage of the graduate employees of the individual branches of the economy; on the nationwide scale this increased from 11.2 percent to 11.8 percent on the average in five years.

The indexes according to industry branches also show the changes in the weight of the R&D base within the branches

	Iparcsoport (3)	K+F dolgozók (1)		K+F ráfordítások (1)	
		az adott iparcsoport (2)			
		aktiv keresőinek %-ában		áruértékesítésének %-ában	
		1970	1975	1970	1975
(4)	Bányászat	1,06	1,32	0,97	0,96
(5)	Villamosenergia ipar	2,36	2,87	0,68	1,33
(6)	Kohászat	1,62	2,06	0,59	0,72
(7)	Gépipar	3,60	3,84	2,98	2,49
(8)	Épitőanyagipar	1,13	1,52	0,69	1,03
(9)	Vegyipar	5,73	6,39	1,89	1,73
(10)	Könnyüipar	0,26	0,39	0,25	0,26
(11)	Élelmiszeripar	0,49	0,62	0,14	0,16
(12)	E g y ü t t :	1,90	2,17	1,33	1,19

Key: 1. R&D workers - R&D expenditures
2. As % of the active wage earners - As % of the sale of the goods of the industry branch
3. Industry branch
4. Mining
5. Electric power industry
6. Metallurgical industry
7. Machine-manufacturing industry
8. Building-materials industry
9. Chemical industry
10. Light industry
11. Food industry
12. Total

Note:

These data pertain to the socialist industry only; this is why there are differences from the corresponding indexes in the preceding tabulation!

According to this tabulation, the percentage of the R&D workers increased in all branches of industry; however, the ratio related to the volume of sales and the R&D expenditure shows a spotty pattern. There was a decrease in three industry branches (mining, machine-manufacturing, and chemical industry), and there was an increase in five. Since the decrease was evident in the branches of industry with the highest sales volume, the industrial average shows a decrease also (the price increases for industrial goods may have contributed to this result also). Finally, we could conclude nonetheless that the R&D branch base showed an increased weight during the course of the last five-year plan period.

Indexes Illustrating the Economic Role of R&D

The tabulation below [next translation page] shows the economic orientation of research and development. Calculated on the basis of data issued by the KSH, it shows the capacity increase (actual or potential) for the individual economy branches between 1971 and 1975 and for the total R&D capacity (based on cost allocations). It indicates the percentage distribution of the new capacities established according to their goals.

This tabulation provides an interesting picture of the orientation conditions of our R&D base. The percentage of the "R&D semifinished products" decreased in the five years; although not high numerically it is much above the average in some areas — primarily in the natural sciences. It is a surprising fact that the well-known industry-orientation of the Hungarian R&D base exists not only in the field of engineering sciences (where this is obvious) but also to various degrees in other sciences. At the same time the degree of orientation is far behind from that observed for the engineering sciences and industry in other relations, which logically should be parallel, such as in agriculture, medical sciences, or health services.

It is an important fact that the entire R&D base growth in five years was for production-related purposes to the tune of almost 80 percent.

In this connection, the KSH (plus other statistical data) permit us to illustrate the growth rate of production and R&D capacity growth rate, which also is a measure of the research-intensiveness of production.*

* D. Gyorgy Szakasits reported about his similar calculations earlier. Janos Kovacs and others examined the research-intensiveness from another angle. We employed a relatively simple method in our calculations.

Fel- (1) használó ágak \ Kibocsátó (2) ágak	(3) Természet	(4) Müszaki	(5) Orvos	(6) Agrár	(7) Társad.	Együtt (8)
	tudományág fejlesztése célok szerint (10)					százalékban (9)
(11) A K+F szférán belüli további felhasználásra	58	2	20	17	26	14
(12) Az egész népgazdaság, vagy több ágazat együtt	2	9	-	1	2	6
(13) Ipar	21	81	12	28	10	56
Épitőipar	0	4	0	1	23	5
(14) Mezőgazdaság	2	1	3	48	1	7
(15) Szállitás és hirközlés	0	3	1	0	1	2
(16) Egészségügyi és kulturális szolgáltatások	0	0	44	0	10	2
(17) Egyéb, fel nem sorolt területek és ismeretlenek együtt	17	0	20	5	27	6
(18) Összesen:	100	100	100	100	100	100

Key:
1. Using branches
2. Issuing branches
3. Natural sciences
4. Engineering sciences
5. Medical sciences
6. Agricultural sciences
7. Social sciences
8. Total
9. In percent
10. Branch development according to goals
11. For further use in the R&D sphere
12. Economy overall or several branches
13. Industry
14. Agriculture
15. Transportation and communication
16. Health and cultural services
17. Others not listed and unknown

From our calculations we find the following for the five-year period examined on the basis of the average yearly growth indexes:

- There was a 1.6 percent increase for every percent average industrial yearly growth (R&D projects serving industrial development); the pattern was quite variable for the science branches: 9.6 percent for agricultural sciences, 3.8 percent for natural sciences, and 2.8 percent for social sciences;

- Every percent of average annual increase in the construction industry was accompanied by a 5.1 percent increase in the R&D expenditures serving the needs of the construction industry;

- The corresponding index for agricultural production was 4.4 percent.

- For the so-called internal development of science, every percent general increase of the R&D expenditures necessitated an only 0.7 percent increase in the corresponding expenditure volume; this was 1 percent in the social sciences, 0.8 percent in the agricultural sciences, 0.7 percent in the natural sciences, and 0.3 percent in the medical sciences (it was 1.2 percent for the engineering sciences, but related to a relatively small sum).

Although our data do not permit us to draw far-reaching conclusions, they do confirm the experience that today our economic growth requires a R&D capacity increase at a faster rate than our economic growth rate. It also expects us to increase the effectiveness of our R&D work. As an antithesis to this, we find that some decrease in the growth rate of the so-called internal science growth — but not a stoppage! — would also be in order.*

* In this connection, we must draw the reader's attention to the fact that such calculations as ours (or similar calculations) cannot very well demonstrate separately this internal growth since the data required for this purpose appear closely intertwined with the data pertaining to "semifinished product"-like R&D activities which ultimately also serve practical purposes. This is another reason why it is dangerous to unduly restrict the internal growth, which not only forms the basis of future R&D activities but may also contribute to the future completion of already started R&D projects. The adverse effects of this would become evident relatively soon. Obviously, in this respect we deal with a problem resembling the determination of the logical ratios of stockpiling and consumption on the level of the national economy, and that further analyses are needed to explore the situation and the problems which require a solution.

We may draw conclusions about the changed role of R&D activities in the national economy also from the ratio changes of the R&D activities of various kinds:

Types (levels)	Percent distribution of the number of themes 1970	1975	of the cost of themes 1970	1975
Fundamental research	14	12	14	14
Applied research	32	32	32	32
Development	54	56	54	54
Total	100	100	100	100

It can be seen from this tabulation that the ratios, based on costs, did not change during the five-year period, and that even on the basis of the number of themes there was only a slight change in the ratios between fundamental research and development in the favor of the latter. This also indicates the fact that the specific cost-intensiveness of the fundamental research themes increased while that of the development projects decreased.

It is a favorable development that the capacity increase of the R&D base in five years was accomplished without a decrease in the final stage of the work, namely the development ratio. (The importance of this fact is further underscored by the fact statistics draws this line in applied research in the field of social sciences, where it does not even mention a development level.)

Although these ratios changed somewhat in the intermediate years, it does seem that the earlier experienced decreasing trend of fundamental research has come to a stop, and that the ratio is now constant at a level that may be regarded satisfactory. There are various factors behind this development: such as the modification in the practical interpretation of fundamental reserach, the increasing emancipation of fundamental research in the institutional system in areas earlier regarded as "applied sciences" in a sterile fashion (such as engineering sciences, medical sciences, agrocultural sciences), and — last but not least — the increased predominance of the planning of complex projects which are subordinated to the goal and specify the capacity required at all levels according to the needs.*

* Earlier, we tended to equate fundamental research with the so-called internal development of science; thus, among the criteria the independence from practical needs was emphasized. However, after completion of the formulation of the science-policy goals, this interpretation became untenable since support of research entirely divorced from practical [footnote continued on next translation page]

THS STRUCTURE OF THE R&D BASE AND ACTIVITIES IN 1975

Institutional Structure

The tabulation below shows the structure of the R&D base according to the main establishment types, based on data for 1975:

(A) Mutató	Kutatóintézetekben (B)	Tanszékeken (C)	Egyéb intézményekben (D)	Együtt (E)
1. Tényleges létszámok:				
1.1 Dolgozók tényleges száma, ezer fő	33,9	19,1	28,2	81,2
1.2 Kutatók száma, ezer fő	11,4	12,6	10,8	34,8
2. Redukált létszámok:				
2.1 Dolgozók száma, ezer fő	33,9	6,7	19,8	60,4
2.1.1 megoszlás %-ban	56 %	11 %	33 %	100 %
2.2 Kutatók száma, ezer fő	11,4	3,9	7,3	22,6
2.2.1 megoszlás %-ban	50 %	17 %	33 %	100 %
3. Ráforditások:				
3.1 Intézményi ráforditások, milliárd Ft	6,9	1,3	4,5	12,7
3.1.1 megoszlás %-ban	54 %	10 %	36 %	100 %
3.2 Beruházások, milliárd Ft	1,5	0,2	0,7	2,4
3.2.1 megoszlás %-ban	63 %	9 %	28 %	100 %

Key: 1. Actual number of employees
- 1.1. Number of actual employees, in thousands
- 1.2. Number of researchers, in thousands
- 2. Reduced numbers of employees
- 2.1. Number of employees, in thousands
- 2.2. Number of researchers, in thousands
- 2.2.1. Distribution in percent
- 3. Expenditures
- 3.1. Institutional expenditures in billion forints
- 3.1.1. Distribution in percent
- 3.2. Investments in billion forints
- 3.2.1. Distribution in percent

[key continued on next translation page]

[footnote continued from preceding page]

needs cannot be approved or supported. Thus, a transformation process has started in which fundamental research more and more became a branch "producing production facilities" within the complex working processes of R&D as a whole, meaning that it creates scientific knowledge to form a foundation for applied research for which there is a practical need and it creates scientific foundations for solving practical problems as they arise. Our present research planning system tries to promote this.

[key continued from preceding translation page]
A. Index
B. In research institutes
C. In university departments
D. In other establishments
E. Total

The ratios did not change from the 1974 level insofar as comparable staff figures are concerned; the expenditure ratios changed slightly in favor of the research institutes and the university departments. The institutes represent the greatest weight, the university departments represent the lowest percentage.

Staff Structure

In the R&D establishments examined, there was a permanent staff of 81,290 as of 31 December 1975. On the average over the year, there were additionally 5,084 temporary employees, including 1,225 retired individuals. Compared to 1974, there was an increase of staff in terms of permanent employees and a decrease in terms of temporary employees(but within the latter an increase of the retired individuals).

On the basis of reduced staff data, the following was the distribution according to the main categories:

Main category	Reduced staff		
	Numbers	% of the actual staff	% distribution
Researchers (including educators and graduate technicians)	22,588	64.9	37
Assistants (including educational and technical assistants)	27,233	79.6	45
Administrative and other (only in institutes and university departments)	10,583	86.1	18
Total	60,404	74.3	100

There were only minor changes from 1974 in terms of the major categories: the percentage of researchers increased and the percentage of administrative and other employees decreased. Although the index reflecting the extent of reduction did not change overall, it did increase for the researchers and assistants, and decrease for the administrative and other employees.

The number of those with an advanced degree was increased nationwide by the fact that in 1975 a total of 77 individuals acquired the degree of doctor of sciences and a total of 268 individuals acquired the degree of candidate of sciences; the former represent 9.9 percent of all doctors of sciences, and the latter represent 5.7 percent of all candidates of sciences (at this rate the number of doctors of sciences would double in 10 years, and the number of candidates of sciences would double in 17.5 years!).

From among those holding an advanced degree, a total of 3,847 individuals (68.5 percent) worked in the R&D establishments examined, in the following distribution:

Kind of degree	Research institutes	University departments	Other establishments	Total
Ordinary and corresponding academicians	45	93	-	138
Doctors of sciences	182	376	78	636
Candidates of sciences	1043	1744	313	3100
Total	1270	2213	391	3874
Distribution in percent	33%	57%	10%	100%
Total as % of researchers	11.5%	18.9%	3.6%	11.5%

There was no significant change from 1974 in the distribution of those with an advanced degree among the various types of establishments; there was a slight shift at the expense of the university departments and in favor of the others. The numbers related to the number of researchers did not change significantly on the national level; there were slight increases in the institutes, slight increases in the university departments, and a slight increase in the other establishments. The ratio is much higher in certain areas:

More than 30 percent in research institutes of the academy;
More than 22 percent in the field of natural sciences.

Expenditure Structure

The total sum expended in the R&D establishments in 1975 was 13,920 million forints. The tabulation below shows the sources and uses of this sum:

SOURCES	Million forints	Distribution in %
1. Technical development fund	9,506.5	68.3
2. State budget	3,984.1	28.6
3. Enterprise profits	426.4	3.1
4. International and foreign sources	3.0	0.0
Total	13.920.0	100.0

USES	Million forints	Distribution in %
1. By the establishments examined including	12,746.5	91.7
1.1. Operating expenses: 10,387.5 million forints		
1.2. Investment expenses: 2,377.0 million forints		
2. MUFA [technical development fund] utilization beyond the examined group	1,096.7	7.9
3. Non-assignable expenses (advanced-degree honoraria, scholarships)	58.8	0.4
Total	13,920.0	100.0
including *		
a. R&D activities	11,413.2	82.0
b. Scientific services	646.5	4.6
c. Experimental production	1,374.8	9.9
d. Other activities (welfare, etc.)	485.5	3.5

Among the sources, there was a slight increase from last year from the MUFA and enterprise profits; there was a slight decrease from the state budget. At the same time, interestingly, the 1975 data reports from the KSH do not show the sums made available from the so-called central research funds (one wonders why?).

The following changes in use took place in 1975:

- There was a decrease in the percentage of expenditures in the R&D establishments examined, and an increase in the percentage of the MUFA uses outside the examined group;

* For Item 1. under "Uses," we used the KSH data and for Item 2. we used our calculations based on the same ratios (estimations).

- There were minor changes in the use ratios according to types of activity: there was a minor increase for R&D activity and experimental production, and a minor increase in the others.

The following are the major components of R&D activity expenditures:

R&D expenses:	9,036.2 million,	79.2 percent
R&D investments:	2,377.0 million,	20.8 percent

The following was the breakdown of R&D investments in 1975:

Construction:	385.4 million forints,	16 percent
Procurement of machinery and instruments:	1,778.6 million forints,	75 percent
Other procurement:	213.0 million forints,	9 percent
Total:	2,377.0 million forints,	100 percent

Within the sums expended for machinery and instrument procurement, import accounted for 1,009.4 million forints in 1975, representing 57 percent. Of this,

Socialist import accounted for	453.9 million forints,	45 percent
Capitalist import accounted for	555.5 million forints,	55 percent

Compared to the previous year, in 1975,

- The investment percentage within the R&D expenditures decreased and the percentage of operating costs increased;

- Within the investment expenditure, the construction investments decreased and the other investments increased;

- Within the sums spent to procure machinery and instruments, the import percentage decreased, and within the import, the percentage of procurement from socialist sources increased.

Science-Branch Structure

On the basis of the main profiles of the observed R&D establishments and their data, as well as on the basis of the science and branch classification introduced, the following science-branch structure emerged in 1975:

Index	Natural	Technical	Medical	Agric.	Social
		s c i e	n c e s		
Distribution indexes (%)					
Number of institutions	16	29	12	14	29
Number of researchers	13	55	7	10	15
Total expenditures	13	65	3	12	7
Total costs	12	65	3	12	8
Specific indexes (%)					
Number of those with advanced degree as % of researchers	22.4	5.0	18.1	13.5	16.5
Female researchers as % of researchers	23.8	21.7	33.3	23.2	34.6
Investments as % of expenditures	28.6	17.8	13.3	17.6	10.6
Successful themes in percent	32.7	53.5	18.7	38.9	44.1

Now that we have changed over to a modernized science-branch and discipline classification system, we lost the means of making comparisons with earlier years in many areas. However, on the basis of our experiences so far we may state that there have been only minimal changes from one year to another, and this applies for 1975 also.

The tables presented at the end of this article provide information about the modernized science-branch structure of the R&D base, which has now been introduced.

Structure According to Supervisory Organs

Insofar as supervisory organs are concerned, the R&D establishments examined were still supervised by a total of 24 supervisory organs in 1975. The percentages are shown in the tabulation below:

Research-supervising organ	Number of institutions	Number of employees	Amount of expenditure
	percentage distribution		
Hungarian Academy of Sciences	2.6	8.9	11.7
Ministry of Education	42.9	14.0	7.2
Ministry of Cultural Affairs	3.7	1.1	0.2
Ministry of Health	13.4	8.2	3.2
Ministry of Agriculture and Food	18.8	13.3	12.8
Industrial ministries, Ministry of Construction and Urban Development, Ministry of Transportation and Postal Affairs	14.9	49.4	58.2
Other ministries and organs of higher jurisdiction	3.7	5.1	6.7
Total	100.0	100.0	100.0

Note: The data for the 99 university departments supervised by the Hungarian Academy of Sciences are listed not under the Academy but under the appropriate supervisory bodies.

There were some noteworthy changes from the distribution of last year: The participation of the Ministries of Cultural Affairs, Health, and the various industries decreased insofar as the number of employees is concerned; the participation of the Hungarian Academy of Sciences, the Ministry of Education, and the Ministry of Agriculture and Food increased insofar as the expenditures are concerned and decreased elsewhere.

Structure of the R&D Activity

Above we have already discussed the structure of the R&D activity in many aspects; here, therefore, we discuss only some additional facets.

The tabulation below shows the number of R&D products per 100 full-time researchers according to institution type in 1975:

In units

Product	Institutes	Departments	Other inst.	Total
Books published	3	15	3	5
Articles published	50	215	36	74
Innovations reported	5	2	75	27
Patents applied for	4	4	14	7
Projects in progress	73	168	217	137

These indexes showed generally slight decreases from the previous year; only the number of articles published in scientific journals increased on the average in the "other R&D establishment" category. The decreases indicate that the quantitative product growth remained behind the increase in intellectual capacity.

Further Prospects of R&D Statistics

After we have reviewed the changes over two decades, the question inevitably arises: what are the major trends of the further domestic development of research statistics?

Main Development Trends

The formulation of the development program for statistics in the field of R&D is underway, based on a surveying of the major current and near-future needs. However, in this article I do not desire to go into this — it will be the subject of another report after finalization — but wish to touch upon those development tasks which in my judgment may become very useful for the users of the statistics.

The following are among the major development goals:

- Further modernization of the KSH publication: revision of the tabular material, elimination of unnecessary information, tabulation structure meeting the needs of analysis, and more featuring of the most important data;

- In the field of the macro indexes, official computation and presentation of the so-called cleaned-up indexes proposed by us;

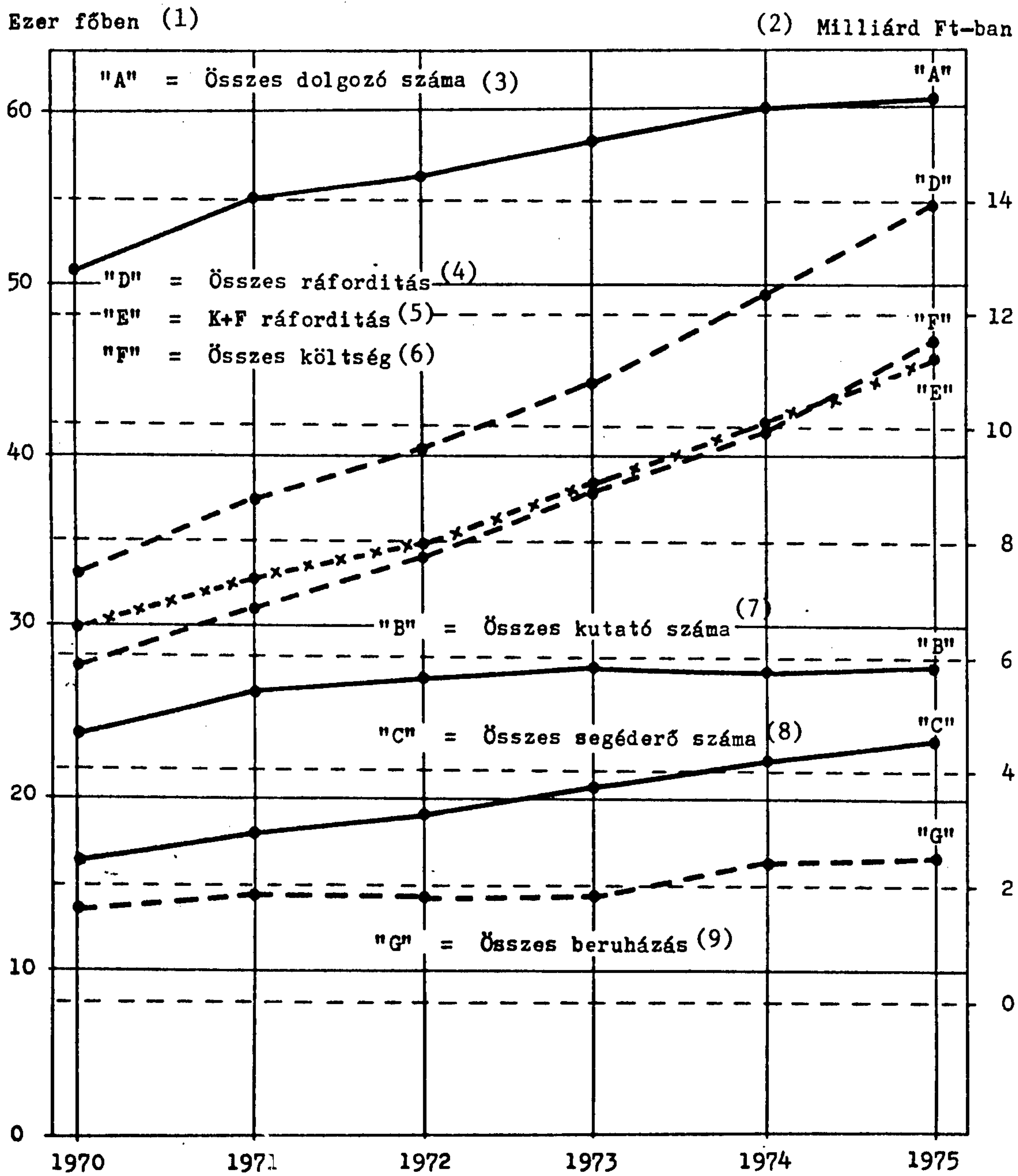
- Extension of the survey to the full or at least representative surveying of the price changes, income changes, and many other data, and the publication of the expenditure volume indexes based on these.

Another important task is the proper solution of the true comparability problems, meaning that it should become possible to make subsequent corrections to enable comparisons to be made with data for earlier years if methodological changes have been made since.

What the whole thing means is that the implementation of the science policy should be monitored. The national and ministry-level supervisory tasks require the information provided by R&D statistics more and more. Some of these can be found in the KSH report directly; others require more or less work involving the processing of the basic data in the required manner.

Remedy is possible, and should be provided in the shortest possible time. This necessitates the more appropriate processing of the data that are available, publishing the required information, and expanding to the desired degree the collection of the data to obtain much more useful information at minimum added effort.

Figure 1. Changes in the Staff and Expenditures of the R&D Establishments Between 1971 and 1975 (in terms of nationwide expenditures, using current prices, the appropriate observations, and equivalency data)



[Key on next translation page]

[Key for Figure 1; preceding page]

1. In thousand persons
2. In billion forints
3. Total number of employees
4. Total expenditure
5. R&D expenditure
6. Total costs
7. Total number of researchers
8. Total number of assistants
9. Total investment

[Key for Figure 2, next translation page]

1. Average annual increase
2. Growth rate of "OR_1" at current prices
3. Growth rate of "OR_2" at constant prices
4. Growth rate of "$BfNj_1$" at current prices
5. Growth rate of "$BfNj_2$" at constant prices
6. Growth rate of "R&D R_1" at current prices
7. Decrease rate of (R&D R2" at constant prices
8. Average annual decrease

Figure 2. Nationwide Expenditures of the R&D Establishments (OR), the Actual R&D Expenditures (R&D R), and the Average Annual Changes of the National Income Spent at Home (BfNj)
(based on current-price and constant-price data)

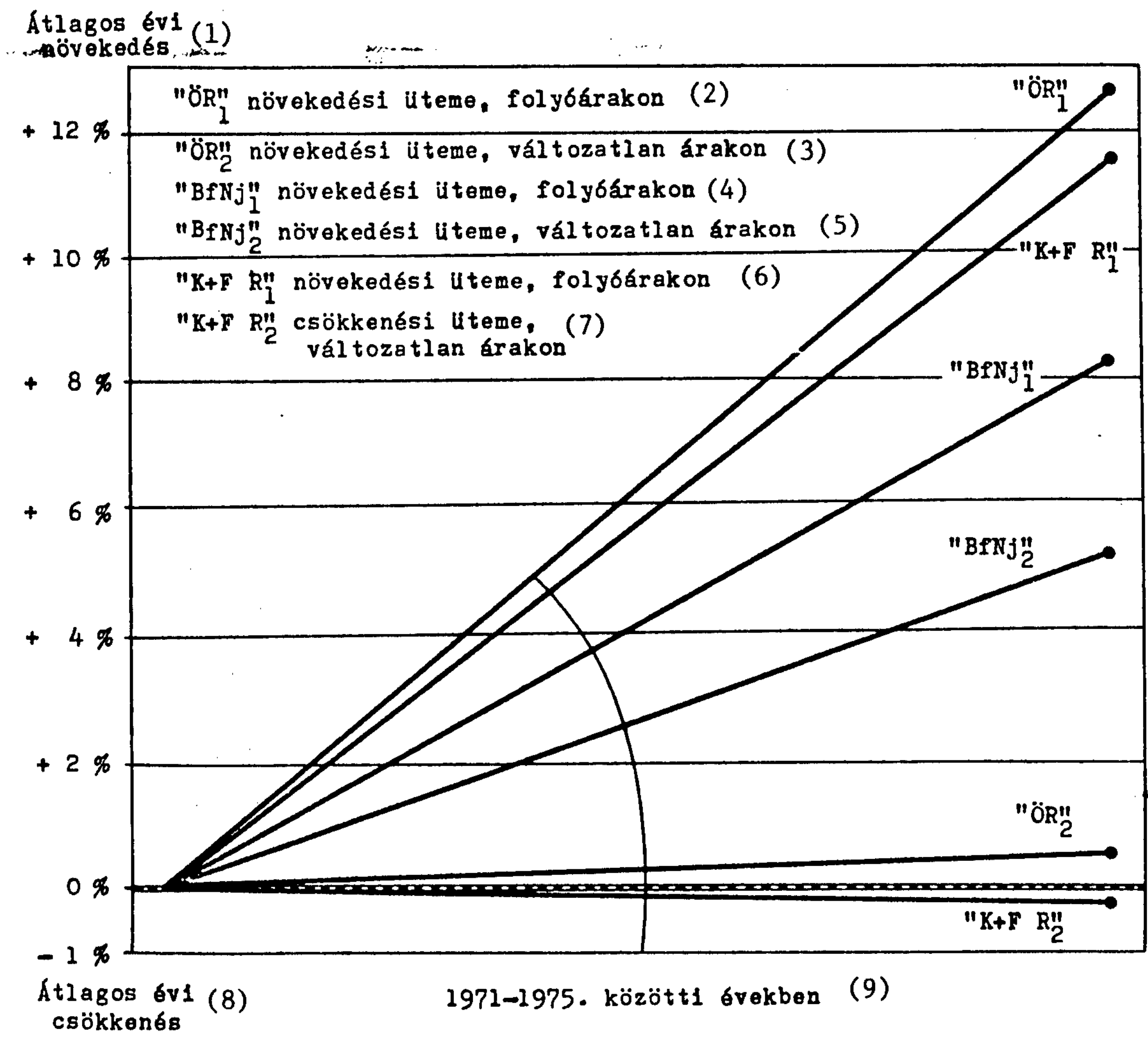


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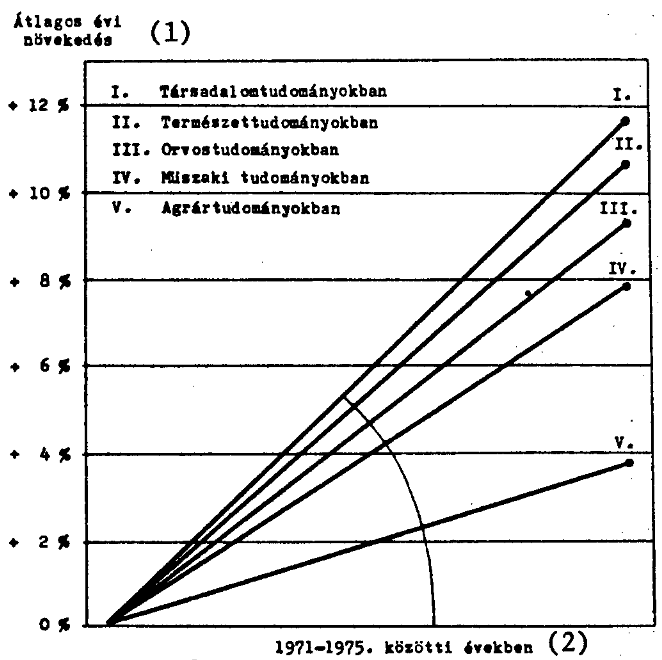
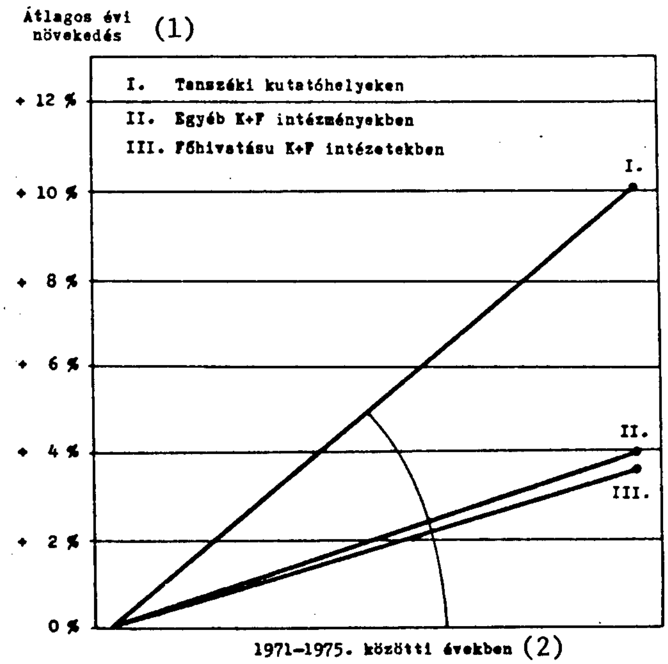
Figure 3. Comparison of the Expenditures per Employee According to Science Branches between 1971 and 1975 in Terms of Annual Growth Rate
(Based on current-price cost data and actual employee count)



Key: 1. Average annual growth
2. Between 1971 and 1975
I. In the social sciences
II. In the natural sciences
III. In the engineering sciences
IV. In the agricultural sciences

Figure 4. Comparison of the Average Annual Growth Rates of the Expenditures per Researcher Between 1971 and 1975
(Based on current-price cost data and reduced research census data)

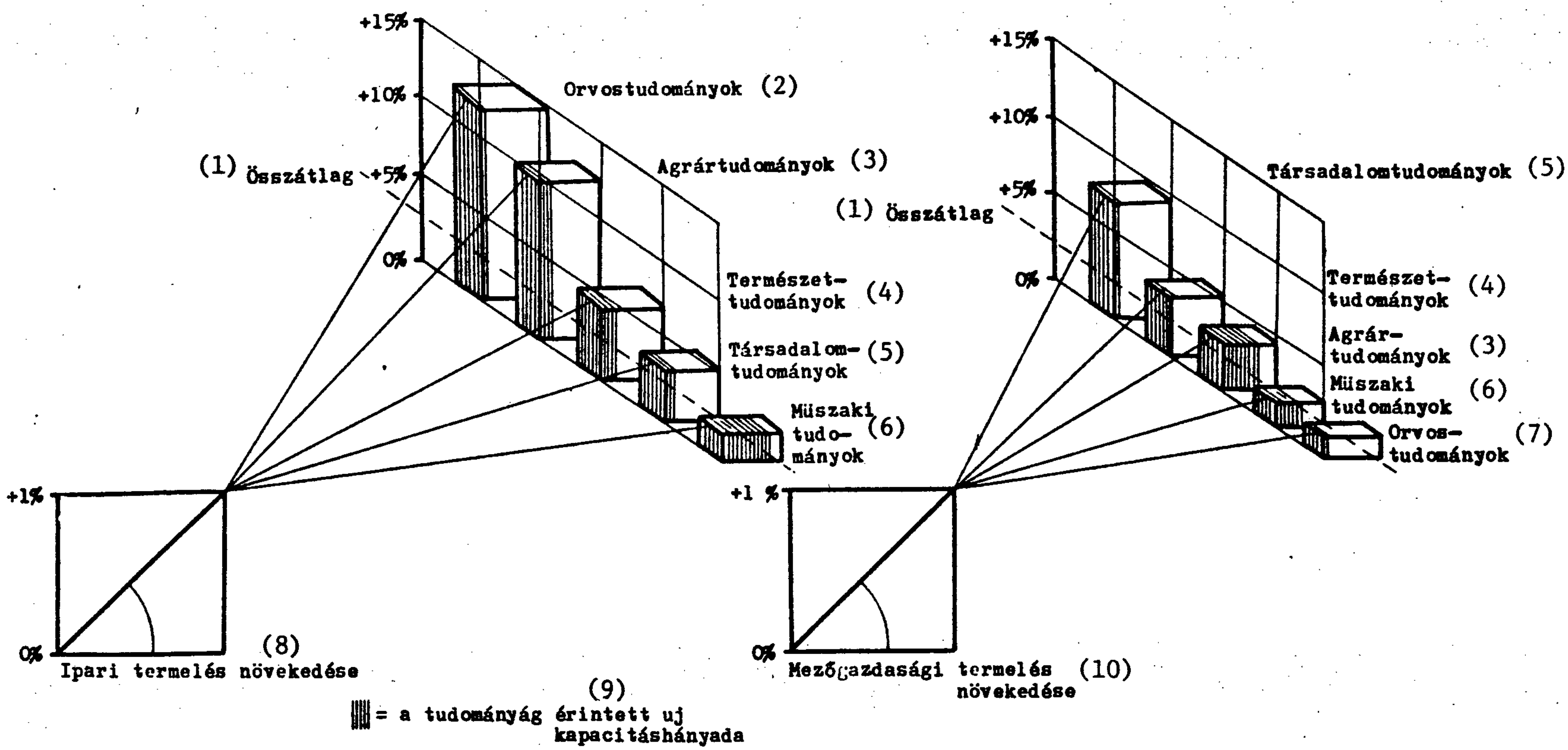


Key:

1. Average annual growth
2. Between 1971 and 1975

I. In university-department research establishments
II. In other R&D establishments
III. In primary research institutes

Figure 5. Illustrating the Research-Intensiveness of Industry and Agriculture Between 1971 and 1975 for the New Science-Branch Capacities Established During This Period (Expressed in percent of cost increase for an average 1 percent increase in the industrial or agricultural production, for research projects serving the needs of the industry and agriculture, according to science branches and on the average)



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[key to Figure 5; preceding page]

1. Overall average
2. Medical sciences
3. Agricultural sciences
4. Natural sciences
5. Social sciences
6. Engineering sciences
7. Medical sciences
8. Growth of industrial production
9. The new capacity percentage of the science branch concerned
10. Growth of agricultural production

Table 1. Number of Research-Development Establishments

(1) Számjel	(2) Tudományág, ágazat	(3) Kutató-intézetek	(4) Tanszékek	Egyéb kutató-fejlesztő helyek (5)	Összes kutató-fejlesztő helyek (7)		
		száma (6)			(6) száma	%-os megoszlása (8)	
						tudományág összesen = 100 (9)	mindösszesen = 100 (10)
2.1	Általános mérnöki (alapozó) K+F	-	25	2	27	6,3	1,8
2.2	Építés	2	26	13	41	9,6	2,8
2.2.1	ebből: magasépítés	-	13	2	15	3,5	1,1
2.2.2	mélyépítés	-	7	3	10	2,3	0,7
2.2.3	építési szak- és szerelőipar	-	3	3	6	1,4	0,4
2.2.4	szilikátipar	1	1	3	5	1,2	0,3
2.3	Bányászat	2	4	12	18	4,2	1,2
2.3.1	ebből: szilárd ásványok bányászata	1	3	8	12	2,8	0,8
2.3.2	nem szilárd ásványok bányászata	1	1	4	6	1,4	0,4
2.4	Kohászat	2	7	19	28	6,5	1,9
2.4.1	ebből: vaskohászat	1	2	11	14	3,3	1,0
2.4.2	aluminiumkohászat	1	-	7	8	1,8	0,5
2.4.3	színes és ritkafém-kohászat	-	-	1	1	0,2	0,1
2.5	Energiagazdálkodás	2	4	3	9	2,1	0,6
2.5.1	ebből: általános energia-gazdálkodás	1	3	1	5	1,2	0,3
2.5.2	villamosenergia gazdálkodás	1	1	2	4	0,9	0,3
2.6	Vegyipar	6	14	32	52	12,1	3,5
2.6.1	ebből: szervetlen	-	1	4	5	1,2	0,3
2.6.2	szerves	5	4	23	32	7,4	2,2
	ezen belül:						
2.6.2.1	gyógyszeripar	1	-	9	10	2,3	0,7
2.6.2.2	gumi- és műanyagipar	1	2	3	6	1,4	0,4
2.7	Gépipar, villamosipar	10	72	78	160	37,3	10,9
2.7.1	ebből: gépgyártástechnológia	1	14	4	19	4,4	1,3
2.7.2	híradástechnika	3	13	12	28	6,4	1,9
2.7.3	műszeripar	1	4	13	18	4,2	1,2
2.7:4	automatizálás, folyamatszabályozás	1	8	2	11	2,6	0,7
2.7.5	számítástechnika	1	2	-	3	0,7	0,2
2.7.6	erősáramu villamos-gépipar	2	8	10	20	4,7	1,4
2.7.7	energetikai gépgyártás	-	1	2	3	0,7	0,2
2.7.8	járműipar	1	6	7	14	3,3	1,0
2.7.9	egyéb gépipar	-	16	28	44	10,3	3,0
2.8	Könnyűipar	2	6	36	44	10,2	2,9
2.8.1	ebből: textilipar	1	2	19	22	5,0	1,5
2.8.2	bőr-, szőrme-, cipőipar	1	1	9	11	2,6	0,7
2.9	Élelmiszeripar	10	9	4	23	5,4	1,6
2.10	Közlekedés	2	6	3	11	2,6	0,7
2.11	Vízgazdálkodás	1	4	5	10	2,3	0,7
2.12	Egyéb műszaki K+F	1	4	1	6	1,4	0,4
	Műszaki tudományok összesen (11)	40	181	208	429	100,0	29,0

[Table continued on next translation page]

[Table 1; continued from preceding page]

(1) Számjel	(2) Tudományág, ágazat	(3) Kutató-intézetek	(4) Tanszékek	(5) Egyéb kutató-fejlesztő helyek	Összes kutató-fejlesztő helyek (7)		
					(6) száma	%-os megoszlása (8)	
						tudományág összesen = 100 (9)	mindösszesen = 100 (10)
		száma (6)					
1.1	Matematika	1	54	-	55	23,2	3,7
1.2	Fizika	3	25	-	28	11,8	1,9
1.3	Kémia	3	41	-	44	18,6	3,0
1.4	Csillagászat	2	1	-	3	1,3	0,2
1.5	Földtudományok	5	36	1	42	17,7	2,8
1.5.1	ebből: földrajz	1	13	-	14	5,9	1,0
1.6	Biológia	3	60	2	65	27,4	4,4
	(12) Természettudományok összesen	17	217	3	237	100,0	16,0
3.1	Elméleti orvostudományok	3	28	-	31	17,0	2,1
3.2	Klinikai orvostudományok	8	85	17	110	60,4	7,4
3.3	Társadalomorvostudományok	5	24	-	29	15,9	2,0
3.4	Gyógyszerészet, gyógyszerkutatás	-	11	1	12	6,7	0,8
	(13) Orvostudományok összesen	16	148	18	182	100,0	12,3
4.1	Növénytermesztés	7	24	3	34	17,0	2,3
4.2	Kertészet	4	20	2	26	13,0	1,8
4.3	Erdészet és vadgazdálkodás	2	12	-	14	7,0	0,9
4.4	Állattenyésztés	3	19	1	23	11,5	1,6
4.5	Mezőgazdaság gépesítése, építészete, villamosítása,	2	38	2	42	21,0	2,8
4.6	Növényvédelem	1	5	-	6	3,0	0,4
4.7	Állatorvostudományok	1	18	1	20	10,0	1,3
4.8	Talajtan	2	10	1	13	6,5	0,9
4.9	Mezőgazdaság üzemtana	-	21	1	22	11,0	1,5
	(14) Agrártudományok összesen	22	167	11	200	100,0	13,5
5.1	Filozófia	1	58	-	59	13,7	4,0
5.2	Pszichológia	1	7	-	8	1,9	0,5
5.3	Demográfia, szociológia	2	2	-	4	0,9	0,3
5.4	Pedagógia	3	33	5	41	9,5	2,8
5.5	Állam- és jogtudományok	1	37	-	38	8,8	2,6
5.6	Kommunikációs kutatások	-	5	2	7	1,6	0,5
5.7	Közgazdaságtudományok	11	40	1	52	12,1	3,5
5.7.1	ebből: politikai gazdaságtan	-	9	-	9	2,1	0,6
5.7.2	ipargazdaságtan	2	4	-	6	1,4	0,4
5.7.3	agrárközgazdaságtan	1	9	-	10	2,3	0,7
5.7.4	egyéb ágazati gazdaságtan	3	7	1	11	2,6	0,7
5.8	Szervezéstan	3	15	3	21	4,9	1,4
5.9	Történelem, régészet, néprajz	3	35	5	43	10,0	2,9
5.10	Nyelvészet, irodalom	2	84	2	88	20,5	6,0
5.11	Művészeti kutatások	2	47	7	56	13,1	3,8
5.12	Egyéb társadalomtudományok	4	4	5	13	3,0	0,9
	(15) Társadalomtudományok összesen	33	367	30	430	100,0	29,2
	(16) *Mindösszesen*	128	1 080	270	1 478	-	100,0

[key on next translation page]

[Key for Table 1; preceding two pages]

1. Code
2. Science branch
3. Research Institutes
4. University departments
5. Other R&D establishments
6. Number of
7. Total research-development establishments
8. Distribution in percent
9. Total, science branch = 100
10. Grand total = 100
11. Engineering sciences, total
12. Natural sciences, total
13. Medical sciences, total
14. Agricultural sciences, total
15. Social sciences, total
16. Grand total

Code numbers (Column 1)

2.1.	General engineering (basic) R&D	
2.2.	Construction	
2.2.1.	including:	above-ground construction
2.2.2.		below-ground construction
2.2.3.		building trades, fitters, installers
2.2.4.		silicate industry
2.3.	Mining	
2.3.1.	including:	solid minerals mining
2.3.2.		non-solid minerals mining
2.4.	Metallurgy	
2.4.1.	including:	ferrous metallurgy
2.4.2.		aluminum metallurgy
2.4.3.		non-ferrour and rare-metal metallurgy
2.5.	Energy systems	
2.5.1.	including:	general energy systems
2.5.2.		electric energy systems
2.6.	Chemical industry	
2.6.1.	including:	inorganic chemical industry
2.6.2.		organic chemical industry
2.6.2.1.		including: pharmaceuticals industry
2.6.2.2.		rubber and plastics industry
2.7.	Machine-manufacturing industry	
2.7.1.	including:	machine-manufacturing technology
2.7.2.		communications technology
2.7.3.		instrument industry
2.7.4.		automation, process control
2.7.5.		computer technology

2.7.6. high-voltage electrical technology
2.7.7. energetic equipment industry
2.7.8. vehicle industry
2.7.9. manufacture of other machinery
2.8. Light industry
2.8.1. including: textile industry
2.8.2. leather, fur, footwear industry
2.9. Food industry
2.10. Transportation
2.11. Water management
2.12 Other engineering R&D
1.1. Mathematics
1.2. Physics
1.3. Chemistry
1.4. Astronomy
1.5. Earth sciences
1.5.1. including: geography
1.6. Biology
3.1. Theoretical medical sciences
3.2. Clinical medical sciences
3.3. Social medical sciences
3.4. Pharmacy, pharmaceutical research
4.1. Plant growing
4.2. Horticulture
4.3. Forestry and wildlife
4.4. Animal breeding
4.5. Agriculture mechanization, construction, electrification
4.6. Plant protection
4.7. Veterinary medical sciences
4.8. Soil science
4.9. Agricultural methods
5.1. Philosophy
5.2. Psychology
5.3. Demography, sociology
5.4. Pedagogy
5.5. Political and legal sciences
5.6. Communication research
5.7. Economic sciences
5.7.1. including: political economics
5.7.2. industrial economics
5.7.3. agricultural economics
5.7.4. other economic aspects
5.8. Management science
5.9. History, archeology, folklore
5.10. Linguistics, literary sciences
5.11. Art studies
5.12 Other social sciences

Table 2. Total Number of the Workers and Researchers of the Research-Development Establishments

(1) Számjel	(2) Tudományág, ágazat	(3) Összes dolgozók	(4) Tudományos kutatók	(6) Teljes munkaidejű dolgozókra átszámított						(13) összes létszámból a tudományos kutatók aránya %-ban
				(7) összlétszám			(8) tudományos kutatói létszám			
				(9) fő	(10) %-os megoszlása		(9) fő	(10) %-os megoszlása		
		(5) tényleges száma			(11) tudományág összesen = 100	(12) mindösszesen = 100		(11) tudományág összesen = 100	(12) mindösszesen = 100	
2.1	Általános mérnöki (alapozó) K+F	814	549	290	0,8	0,5	194	1,6	0,9	66,9
2.2	Építés	3 379	1 479	2 493	6,7	4,1	958	7,7	4,2	38,4
2.2.1	ebből: magasépítés	626	407	300	0,8	0,5	185	1,5	0,8	61,7
2.2.2	mélyépítés	303	204	89	0,2	0,1	54	0,4	0,2	60,7
2.2.3	építési szak- és szerelőipar	165	92	82	0,2	0,1	46	0,4	0,2	56,1
2.2.4	szilikátipar	1 281	402	1 141	3,1	1,9	374	3,0	1,7	32,8
2.3	Bányászat	1 779	593	1 321	3,7	2,2	453	3,7	2,0	34,3
2.3.1	ebből: szilárd ásványok bányászata	1 106	316	865	2,4	1,4	259	2,1	1,1	29,9
2.3.2	nem szilárd ásványok bányászat	673	277	456	1,3	0,8	194	1,6	0,9	42,5
2.4	Kohászat	1 869	745	1 517	4,1	2,5	552	4,5	2,4	36,4
2.4.1	ebből: vaskohászat	992	389	776	2,1	1,3	269	2,3	1,2	34,7
2.4.2	aluminiumkohászat	740	290	660	1,8	1,0	246	2,0	1,0	37,3
2.4.3	színes és ritkafém-kohászat	64	21	43	0,1	0,1	18	0,1	0,1	41,9
2.5	Energiagazdálkodás	1 672	550	1 165	3,2	1,9	342	2,8	1,5	29,4
2.5.1	ebből: általános energia-gazdálkodás	474	116	448	1,2	0,7	100	0,8	0,4	22,3
2.5.2	villamosenergia gazdálkodás	1 198	434	717	2,0	1,2	242	2,0	1,1	33,8
2.6	Vegyipar	8 135	2 713	6 708	18,4	11,1	2 069	16,7	9,2	30,8
2.6.1	ebből: szervetlen	305	113	244	0,7	0,4	83	0,7	0,4	34,0
2.6.2	szerves	6 342	1 990	5 371	14,7	8,9	1 595	12,9	7,1	29,7
	ezen belül:									
2.6.2.1	gyógyszeripar	3 289	1 077	2 569	7,0	4,3	788	6,4	3,5	30,7
2.6.2.2	gumi- és műanyagipar	1 053	332	969	2,7	1,6	292	2,3	1,3	30,1
2.7	Gépipar, villamosipar	23 709	8 224	18 561	51,0	30,7	6 266	50,3	27,8	33,8
2.7.1	ebből: gépgyártástechnológia	1 318	548	968	2,7	1,6	350	2,8	1,6	36,2
2.7.2	híradástechnika	7 794	2 537	6 537	17,9	10,8	2 149	17,3	9,5	32,9
2.7.3	műszeripar	3 631	1 260	2 965	8,1	4,9	1 010	8,1	4,5	34,1
2.7.4	automatizálás, folyamatszabályozás	1 057	504	895	2,5	1,5	411	3,3	1,8	45,9
2.7.5	számítástechnika	586	257	556	1,5	0,9	246	2,0	1,1	44,2
2.7.6	erősáramu villamos-gépipar	3 464	1 182	2 700	7,4	4,5	810	6,5	3,6	30,0
2.7.7	energetikai gép-gyártás	169	76	109	0,3	0,2	42	0,3	0,2	38,5
2.7.8	járműipar	2 512	842	1 771	4,9	2,9	562	4,5	2,5	31,7
2.7.9	egyéb gépipar	3 178	1 018	2 060	5,7	3,4	686	5,5	3,0	33,3
2.8	Könnyűipar	1 757	582	1 339	3,7	2,2	404	3,2	1,8	30,2
2.8.1	ebből: textilipar	982	300	738	2,0	1,2	189	1,5	0,8	25,6
2.8.2	bőr-, szőrme-, cipőipar	544	175	470	1,3	0,8	151	1,2	0,7	32,1
2.9	Élelmiszeripar	1 347	472	1 244	3,4	2,1	425	3,4	1,9	34,2
2.10	Közlekedés	972	471	889	2,4	1,5	412	3,3	1,8	46,3
2.11	Vízgazdálkodás	824	327	721	2,0	1,2	267	2,2	1,2	37,0
2.12	Egyéb műszaki K+F	299	110	230	0,6	0,4	75	0,6	0,3	32,6
(14)	Műszaki tudományok összesen	46 576	16 815	36 478	100,0	60,4	12 417	100,0	55,0	34,0

[continued on next translation page]

[Table 2; continued from preceding page]

Számjel	Tudományág, ágazat	Összes dolgozók	Tudományos kutatók a/	Teljes munkaidejű dolgozókra átszámított: összlétszám: fő	összlétszám: %-os megoszlása: tudományág összesen = 100	összlétszám: %-os megoszlása: mindösszesen = 100	tudományos kutatói létszám a/: fő	tudományos kutatói létszám: %-os megoszlása: tudományág összesen = 100	tudományos kutatói létszám: %-os megoszlása: mindösszesen = 100	összes létszámból a tudományos kutatók aránya %-ban
		tényleges száma								
1.1	Matematika	1 008	737	374	5,1	0,6	273	9,3	1,2	73,0
1.2	Fizika	3 404	1 371	3 013	41,1	5,0	1 121	38,1	5,0	37,2
1.3	Kémia	2 222	974	1 593	21,7	2,6	636	21,6	2,8	39,9
1.4	Csillagászat	93	41	88	1,2	0,2	37	1,3	0,2	42,1
1.5	Földtudományok	1 360	619	1 001	13,7	1,6	398	13,5	1,8	39,8
1.5.1	ebből: földrajz	198	122	132	1,8	0,2	70	2,4	0,3	53,0
1.6	Biológia	1 890	823	1 260	17,2	2,1	479	16,2	2,1	38,0
	(15) Természettudományok összesen	9 977	4 565	7 329	100,0	12,1	2 944	100,0	13,1	40,2
3.1	Elméleti orvostudományok	1 369	517	1 004	27,5	1,7	338	20,8	1,5	33,7
3.2	Klinikai orvostudományok	3 098	2 253	1 391	38,1	2,3	772	47,5	3,4	55,5
3.3	Társadalomorvostudományok	1 316	596	1 032	28,3	1,7	418	25,7	1,9	40,5
3.4	Gyógyszerészet, gyógyszerkutatás	393	185	221	6,1	0,4	98	6,0	0,4	44,3
	(16) Orvostudományok összesen	6 176	3 551	3 648	100,0	6,1	1 626	100,0	7,2	44,6
4.1	Növénytermesztés	2 248	668	1 929	26,8	3,2	472	20,5	2,1	24,5
4.2	Kertészet	1 414	507	1 264	17,6	2,1	411	18,0	1,8	32,5
4.3	Erdészet, vadgazdálkodás	540	179	489	6,8	0,8	146	6,4	0,6	29,9
4.4	Állattenyésztés	827	348	707	9,8	1,2	270	11,8	1,2	38,2
4.5	Mezőgazdaság gépesítése, építészete, villamosítása	2 336	818	1 930	26,8	3,2	601	26,3	2,6	31,1
4.6	Növényvédelem	245	127	181	2,5	0,3	82	3,6	0,4	45,3
4.7	Állatorvostudományok	430	191	261	3,6	0,4	108	4,7	0,5	41,4
4.8	Talajtan	375	153	310	4,3	0,5	112	4,9	0,5	36,1
4.9	Mezőgazdaság üzemtana	335	245	126	1,8	0,2	87	3,8	0,4	69,1
	(17) Agrártudományok összesen	8 750	3 236	7 197	100,0	11,9	2 289	100,0	10,1	31,8
5.1	Filozófia	755	643	168	2,9	0,3	138	4,2	0,6	82,1
5.2	Pszichológia	176	112	115	2,0	0,2	65	2,0	0,3	56,5
5.3	Demográfia, szociológia	122	70	103	1,8	0,2	55	1,6	0,2	53,4
5.4	Pedagógia	783	605	408	7,1	0,7	293	8,9	1,3	71,8
5.5	Állam- és jogtudományok	288	223	129	2,2	0,2	94	2,8	0,4	72,9
5.6	Kommunikációs kutatások	104	77	50	0,9	0,1	35	1,1	0,2	70,0
5.7	Közgazdaságtudományok	1 558	1 013	1 131	19,7	1,9	659	19,9	2,8	58,3
5.7.1	ebből: politikai gazdaságtan	165	146	36	0,6	0,1	32	1,0	0,1	88,9
5.7.2	ipargazdaságtan	177	125	130	2,3	0,2	87	2,6	0,4	66,9
5.7.3	agrárközgazdaságtan	345	187	273	4,8	0,5	139	4,2	0,6	50,9
5.7.4	egyéb ágazati gazdaságtan	351	238	266	4,6	0,4	167	5,0	0,7	62,8
5.8	Szervezéstan	2 207	1 012	1 893	32,9	3,1	763	23,0	3,4	40,3
5.9	Történelem, régészet, néprajz	792	536	460	8,0	0,7	268	8,1	1,2	58,3
5.10	Nyelvészet, irodalom	1 276	1 081	452	7,9	0,7	358	10,8	1,6	79,2
5.11	Művészeti kutatások	796	653	197	3,4	0,3	134	4,0	0,6	68,0
5.12	Egyéb társadalomtudományok	953	606	646	11,2	1,1	450	13,6	2,0	69,7
	(18) Társadalomtudományok összesen	9 810	6 631	5 752	100,0	9,5	3 312	100,0	14,6	57,6
	(19) *Mindösszesen*	81 289	34 798	60 404	-	100,0	22 588	-	100,0	37,4

(20) a/ Beleértve a tanszéki oktatók és az egyéb kutatóhelyi diplomások létszámát is.

[key on next translation page]

[key for Table 2; two preceding pages]

1. Code
2. Science branch
3. Total workers
4. Scientific researchers
5. Actual number
6. Converted to full-time workers
7. Total number
8. Scientific researcher staff
9. Number of individuals
10. Percentage distribution
11. Science branch total = 100
12. Grand total = 100
13. Percent of scientific researchers from total staff
14. Engineering sciences, total
15. Natural sciences, total
16. Medical sciences, total
17. Agricultural sciences, total
18. Social sciences, total
19. Grand total
20. a) Including the educators in university departments and graduates in other research establishments

Codes: [See following the translation of Table 1]

Table 3. Costs and Expenditures of the Research-Development Establishments

(1) Számjel	(2) Tudományág, ágazat	Kutatási-fejlesztési ráfordítások (3)			(16) Ebből a költségek			(9) A kutatási ráfordításokból a beruházások aránya %-ban
		(4) millió Ft-ban	(5) %-os megoszlása: tudományág összesen = 100 (6)	(5) %-os megoszlása: mind-összesen = 100 (7)	millió Ft-ban (8)	(5) %-os megoszlása: tudományág összesen = 100 (6)	(5) %-os megoszlása: mind-összesen = 100 (7)	
2.1	Általános mérnöki (alapozó) K+F	78,4	1,0	0,6	66,9	0,9	0,6	14,8
2.2	Építés	507,5	6,1	3,9	405,2	6,0	3,9	20,2
2.2.1	ebből: magasépítés	80,2	1,0	0,6	71,2	1,0	0,7	11,2
2.2.2	mélyépítés	30,2	0,4	0,2	25,0	0,4	0,2	17,1
2.2.3	építési szak- és szerelőipar	20,1	0,2	0,1	19,7	0,3	0,2	2,2
2.2.4	szilikátipar	191,2	2,3	1,5	160,4	2,4	1,5	16,1
2.3	Bányászat	249,2	3,0	2,0	210,7	3,1	2,0	15,4
2.3.1	ebből: szilárd ásványok bányászata	123,1	1,5	1,0	104,6	1,5	1,0	15,0
2.3.2	nem szilárd ásványok bányászata	126,1	1,5	1,0	106,1	1,6	1,0	15,9
2.4	Kohászat	354,3	4,3	2,8	285,1	4,2	2,7	19,5
2.4.1	ebből: vaskohászat	233,4	2,8	1,8	176,2	2,6	1,7	24,5
2.4.2	aluminiumkohászat	98,2	1,2	0,8	87,2	1,3	0,9	11,1
2.4.3	színes és ritkafém-kohászat	13,4	0,2	0,1	13,4	0,2	0,1	-
2.5	Energiagazdálkodás	362,8	4,4	2,8	244,8	3,6	2,3	32,5
2.5.1	ebből: általános energia-gazdálkodás	102,8	1,2	0,8	97,7	1,4	0,9	4,9
2.5.2	villamosenergia gazdálkodás	260,0	3,2	2,0	147,1	2,2	1,4	43,4
2.6	Vegyipar	1 445,1	17,4	11,3	1 192,6	17,6	11,5	17,5
2.6.1	ebből: szervetlen	41,8	0,5	0,3	40,7	0,6	0,4	2,7
2.6.2	szerves	1 160,2	14,0	9,1	968,9	14,3	9,3	16,5
	ezen belül:							
2.6.2.1	gyógyszeripar	532,1	6,4	4,2	440,9	6,5	4,2	17,1
2.6.2.2	gumi- és műanyagipar	193,6	2,3	1,5	156,2	2,3	1,5	19,3
2.7	Gépipar, villamosipar	4 459,6	53,9	34,9	3 724,1	54,8	35,9	16,5
2.7.1	ebből: gépgyártástechnológia	237,5	2,9	1,8	163,2	2,4	1,6	31,3
2.7.2	híradástechnika	1 844,2	22,3	14,5	1 485,0	21,9	14,3	19,5
2.7.3	műszeripar	617,0	7,5	4,8	548,2	8,1	5,3	11,1
2.7.4	automatizálás, folyamatszabályozás	223,4	2,7	1,8	183,8	2,7	1,8	17,7
2.7.5	számítástechnika	185,9	2,2	1,5	147,6	2,2	1,4	20,6
2.7.6	erősáramú villamosgépipar	503,4	6,1	3,9	466,8	6,8	4,5	7,3
2.7.7	energetikai gépgyártás	42,8	0,5	0,3	41,7	0,6	0,4	2,6
2.7.8	járműipar	417,2	5,0	3,3	342,5	5,0	3,3	17,9
2.7.9	egyéb gépipar	388,2	4,7	3,0	345,3	5,1	3,3	11,1
2.8	Könnyűipar	266,9	3,2	2,1	231,6	3,4	2,3	13,2
2.8.1	ebből: textilipar	124,1	1,5	1,0	100,7	1,5	1,0	18,8
2.8.2	bőr-, szőrme-, cipőipar	102,7	1,2	0,8	95,1	1,4	1,0	7,4
2.9	Élelmiszeripar	180,2	2,2	1,4	153,7	2,3	1,5	14,7
2.10	Közlekedés	136,6	1,7	1,1	99,4	1,5	1,0	27,2
2.11	Vízgazdálkodás	198,5	2,4	1,6	153,3	2,2	1,5	22,8
2.12	Egyéb műszaki K+F	33,4	0,4	0,3	29,9	0,4	0,3	10,5
	(10) Műszaki tudományok összesen	8 272,5	100,0	64,8	6 797,3	100,0	65,5	17,8

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[Table 3; continued from preceding page]

Számjel	Tudományág, ágazat	Kutatási-fejlesztési ráfordítások			Ebből a költségek			A kutatási ráfordításokból a beruházások aránya %-ban
		millió Ft-ban	%-os megoszlása: tudományág összesen =100	%-os megoszlása: mind-összesen = 100	millió Ft-ban	%-os megoszlása: tudományág összesen = 100	%-os megoszlása: mind-összesen = 100	
1.1	Matematika	92,1	5,3	0,7	45,7	3,7	0,4	50,4
1.2	Fizika	830,3	48,0	6,5	588,5	47,7	5,7	29,1
1.3	Kémia	298,4	17,2	2,3	211,9	17,2	2,0	28,5
1.4	Csillagászat	20,1	1,2	0,2	11,8	1,0	0,1	41,3
1.5	Földtudományok	342,1	19,8	2,6	260,6	21,1	2,5	23,8
1.5.1	ebből: földrajz	18,4	1,1	0,1	15,0	1,2	0,1	18,5
1.6	Biológia	147,3	8,5	1,2	115,4	9,3	1,1	21,6
	(11) Természettudományok összesen	1 728,3	100,0	13,5	1 233,9	100,0	11,8	28,6
3.1	Elméleti orvostudományok	96,4	23,4	0,8	76,8	21,5	0,7	20,4
3.2	Klinikai orvostudományok	169,9	41,3	1,2	153,7	43,1	1,5	9,5
3.3	Társadalomorvostudományok	125,9	30,6	1,0	108,1	30,3	1,0	14,1
3.4	Gyógyszerészet, gyógyszerkutatás	19,3	4,7	0,2	18,0	5,1	0,2	6,7
	(12) Orvostudományok összesen	411,5	100,0	3,2	356,6	100,0	3,4	13,3
4.1	Növénytermesztés	487,3	33,1	3,8	387,3	31,9	3,7	20,5
4.2	Kertészet	324,6	22,0	2,5	260,9	21,5	2,5	19,6
4.3	Erdészet, vadgazdálkodás	62,7	4,3	0,5	55,5	4,6	0,5	11,4
4.4	Állattenyésztés	179,9	12,2	1,4	155,1	12,8	1,5	13,8
4.5	Mezőgazdaság gépesítése, építészete, villamosítása	280,2	19,0	2,2	235,8	19,4	2,3	15,8
4.6	Növényvédelem	32,8	2,2	0,3	28,1	2,3	0,3	14,2
4.7	Állatorvostudományok	33,7	2,3	0,3	27,0	2,2	0,3	19,8
4.8	Talajtan	51,7	3,5	0,4	44,8	3,7	0,4	13,4
4.9	Mezőgazdaság üzemtana	20,5	1,4	0,2	19,8	1,6	0,2	3,3
	(13) Agrártudományok összesen	1 473,4	100,0	11,6	1 214,3	100,0	11,7	17,6
5.1	Filozófia	17,7	2,0	0,1	17,4	2,2	0,2	1,2
5.2	Pszichológia	13,8	1,6	0,1	9,5	1,2	0,1	31,5
5.3	Demográfia, szociológia	9,8	1,1	0,1	9,5	1,2	0,1	3,4
5.4	Pedagógia	52,1	5,9	0,4	51,0	6,5	0,5	2,1
5.5	Állam- és jogtudományok	12,6	1,4	0,1	11,4	1,5	0,1	9,8
5.6	Kommunikációs kutatások	7,4	0,9	0,1	7,3	0,9	0,1	0,8
5.7	Közgazdaságtudományok	134,5	15,3	1,0	121,9	15,6	1,2	9,4
5.7.1	ebből: politikai gazdaságtan	3,9	0,4	0,0	3,9	0,5	0,0	0,1
5.7.2	ipargazdaságtan	15,3	1,7	0,1	14,8	1,9	0,1	3,5
5.7.3	agrárközgazdaságtan	25,5	2,9	0,2	25,0	3,2	0,3	1,9
5.7.4	egyéb ágazati gazdaságtan	33,2	3,8	0,3	32,1	4,1	0,3	3,3
5.8	Szervezéstan	354,2	40,3	2,8	293,9	37,4	2,8	17,0
5.9	Történelem, régészet, néprajz	42,9	4,9	0,3	40,2	5,1	0,4	6,4
5.10	Nyelvészet, irodalom	34,6	4,0	0,3	34,2	4,3	0,3	1,2
5.11	Művészeti kutatások	23,2	2,6	0,2	22,0	2,8	0,2	5,2
5.12	Egyéb társadalomtudományok	176,0	20,0	1,4	167,2	21,3	1,6	5,0
	(14) Társadalomtudományok összesen	878,6	100,0	6,9	785,4	100,0	7,6	10,6
	(15) *Mindösszesen*	12 764,5	-	100,0	10 387,5	-	100,0	18,6

[key on next translation page]

[key for Table 3; two preceding pages]

1. Code
2. Science branch
3. Research-development allocations
4. In million forints
5. Percent distribution
6. Science branch total = 100
7. Grand total = 100
8. In million forints
9. Percentage of investment of the research allocations
10. Engineering sciences, total
11. Natural sciences, total
12. Medical sciences, total
13. Agricultural sciences, total
14. Social sciences, total
15. Grand total
16. Of these--expenditures are:

Codes: [See following translation of Table 1]

Note for Table 4 [next translation page]

a) In this table, the data for the university departments under the scientific supervision of the MTA are listed under the Ministries of Education, Health, and Agriculture and Food. The total data for these university departments are the following in the order of the columns: 99; 3,174; 230.4; 59.5; 824.

Table 4. Major Data for Research and Development According to the Organs Supervising the Research-Development Establishment

4.táblázat

A KUTATÁS–FEJLESZTÉS FŐBB ADATAI A KUTATÓ–FEJLESZTŐ HELYEK FELÜGYELETI SZERVE SZERINT

(1) Minisztérium, főhatóság	(2) Kutató-fejlesztő helyek száma	(3) Az összes dolgozók tényleges száma	(4) Kutatási - fejlesztési (5) költségek	(6) beruházások	(7) ráfordítások	(9) Munkában lévő kutatási témák száma
			(8) millió Ft-ban			
(10) Magyar Tudományos Akadémia[a]	38	7 232	1 087, 0	408, 0	1 495, 0	1 105
(11) Oktatási Minisztérium	634	11 405	743, 8	180, 5	924, 3	4 443
(12) Kulturális Minisztérium	55	920	23. 7	1, 2	24, 9	391
(13) Egészségügyi Minisztérium	198	6 684	358, 9	49, 3	408, 2	1 459
(14) Mezőgazdasági és Élelmezésügyi Minisztérium	278	10 767	1 352, 9	273, 9	1 626, 8	3 465
(15) Kohó- és Gépipari Minisztérium	96	22 009	3 574, 5	653, 0	4 227, 5	10 969
(16) Nehézipari Minisztérium	61	11 403	1 647, 9	406, 4	2 054, 3	3 814
(17) Könnyűipari Minisztérium	42	1 870	249, 5	34, 4	283, 9	1 347
(18) Építésügyi és Városfejlesztési Minisztérium	14	3 568	514, 9	143, 9	658, 8	1 593
(19) Közlekedés- és Postaügyi Minisztérium	8	1 320	141, 5	61, 3	202, 8	858
(20) Belkereskedelmi Minisztérium	8	218	12, 1	0, 0	12, 1	52
(21) Pénzügyminisztérium	1	59	5, 9	0. 0	5, 9	30
(22) Országos Műszaki Fejlesztési Bizottság	4	882	153, 6	49, 2	202, 8	191
(23) Központi Statisztikai Hivatal	3	492	65, 6	-	65, 6	101
(24) Országos Tervhivatal	1	76	7, 9	-	7, 9	15
(25) Központi Földtani Hivatal	2	535	195, 4	52, 3	247, 7	50
(26) Országos Vízügyi Hivatal	7	759	142, 1	56, 7	198, 8	524
(27) Szakszervezetek Országos Tanácsa	2	254	33, 0	3, 3	36, 3	86
(28) Országos Testnevelési és Sporthivatal	10	170	6, 1	0, 5	6, 6	40
(29) Budapest Főváros Tanácsa	7	215	25, 2	1, 7	26, 9	112
(30) Munkaügyi Minisztérium	6	327	29, 0	0, 9	29, 9	69
(31) Külkereskedelmi Minisztérium	1	38	7, 6	0, 3	7, 9	32
(32) Külügyminisztérium	1	32	4, 8	-	4, 8	45
(33) Szövetkezetek Országos Szövetsége	1	54	4, 6	0, 2	4, 8	48
(34) *Mindösszesen*	1 478	81 289	10 387, 5	2 377, 0	12 764, 5	30 839

a/ Az MTA tudományos irányitása alá tartozó tanszékek adatai a táblázatban az Oktatási, Egészségügyi, valamint a Mezőgazdasági és Élelmezésügyi Minisztérium sorában szerepelnek. Ezeknek a tanszékeknek együttes adatai az oszlopok sorrendjében a következők: 99; 3 174; 230,4; 59,5; 289,9; 824.

[key on next translation page]

[key for Table 4; preceding page]

1. Ministry, government organ
2. Number of research-development establishments
3. Actual number of all employees
4. Research-development
5. Expenditures
6. Investments
7. Disbursements
8. In million forints
9. Number of research themes in progress
10. Hungarian Academy of Sciences
11. Ministry of Education
12. Ministry of Cultural Affairs
13. Ministry of Health
14. Ministry of Agriculture and Food
15. Ministry of Metallurgy and Machine Manufacture
16. Ministry of Heavy Industry
17. Ministry of Light Industry
18. Ministry of Construction and Urban Development
19. Ministry of Transportation and Postal Affairs
20. Ministry of Domestic Trade
21. Ministry of Finance
22. National Technical Development Committee
23. Central Statistical Bureau
24. National Planning Bureau
25. Central Geodetic Bureau
26. National Water Affairs Bureau
27. National Council of Trade Unions
28. National Bureau for Physical Education and Sports
29. Council of the Capital City of Budapest
30. Ministry of Labor
31. Ministry of Foreign Trade
32. Ministry of Foreign Affairs
33. National Union of Cooperatives
34. Total

a) [See translation page preceding the Table 4]

2542
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HUNGARY

SOME ADMINISTRATIVE PROBLEMS OF INTERDISCIPLINARY STUDIES

Budapest TUDOMANYSZERVEZESI TAJEKOZTATO in Hungarian Vol 18 No 3-4, 1977 pp 361-367

[Article by Dr Gyorgy Gerle]

[Text] The Unified Network Plan of Interdisciplinary Studies - Lack of Overall Concepts in Urbanistics - Lack of the "Methodology" of Complex Studies - Basic and Advanced Training of New Types of Experts - Lack of a "Host" for Interdisciplinarity

One of the major prerequisites for the unfolding of the scientific and technological revolution is the effective creation of the organizational framework , the intellectual framework, and the economic framework for effective research and development. It appears that we have largely met this condition since, on the one hand, we expended more than 3 percent of our national income for this purpose — which is a percentage found in the most advanced countries — and, on the other hand, we have taken great care for a long time to make our research activities planned and systematic. This is illustrated by the first National Long-Range Scientific Research Plan, which was promulgated in 1960, the Science Policy Guidelines promulgated by the MSZMP KB [Central Committee of the Hungarian Socialist Workers Party] in 1969, and others. It was on the basis of these documents that a new OTTKT [National Long-Range Scientific Research Plan] was developed in 1972, which covers the period until 1990. This latter plan was recently re-evaluated and combined into 11 national-level long-range specific programs, while the projects of special interest to a ministry or national organs were combined into departmental programs, or — if they needed no branch coordination but were of appropriate scientific character that this was warranted — were included among one of the six national "main research directions" supported and managed by the MTA [Hungarian Academy of Sciences] or another appropriate body. In addition to these overall projects, studies may

also be carried out "freely," if they do not fall in any of the above categories but if an enterprise or institution has a need for them and can perform it from its own resources. Also, there are ways and means for approving projects which are of the "hobby" kind — not in the pejorative sense of the term — which are carried out by individual scientists if they have the time according to their own special interests ("curiosities"?). The results of many of these projects eventually become useful for industry or become the starting point for a major, approved project. Thus, they should be tolerated and even supported if they are found to have merit.

In this article, however, our goal is not to demonstrate and evaluate the positive aspects but to point out certain problems which arose in the field of human ecology and urbanistics, and of which the solution would contribute materially toward the effectiveness of our scientific activities and which could also be useful in other areas of science.

Insofar as these problems are concerned, they have the interesting feature of being interdisciplinary in character. And we know from experience that we are still not very well prepared for the organization, coordination, and synthesis of interdisciplinary studies and their results. Yet, it is in this area that the use of the conflicting results of individual science branches usually creates new problems or points out certain impossibilities. In this connection we should mention a number of phenomena.

The Unified Network Plan of Interdisciplinary Studies

In principle the program of all studies, particularly of interdisciplinary studies, must be prepared on the basis of a scientific goal. In the course of formulating the program, we must organize the organs capable of performing the required tasks, the individuals involved, and all activities totether with their individual goals in a single unified network plan. Such a plan would connect "in series" the various sub-tasks which are in a sequential relationship to ensure that the preliminary steps are completed for each and every subsequent step and ultimately for the synthesis of all results in a unified form. The planning also means a strict sequential scheme since there are many sub-tasks which assume the completion of a previous task. Failure to observe this often gives us not a practically useful and integrated result but a jumble of part results from which the user will pick and choose on the basis of his subjective criteria. This is then a hotbed of arbitrary decisions, and in addition it leads to the use of arbitrarily selected part results as "qasi-scientific foundation" or in the vernacular of the research activities, for "ideologization."

In the case of complex research projects of which the solution logically extends beyond the task system capable of being accomodated within a single

network plan, we must make sure that the inward and outward relationships of the network plan concerned with the other related network plans are properly taken into consideration, meaning that we must take into account the various prerequisite and consequence factors of the other plans also. So as to discuss this matter not purely in theoretical terms, let us examine, as an example, National Long-Range Research Target Program K-5, dealing with "The Optimum Development of Human Macro and Micro Environment." Let us think, for example, of the target program of the studies aimed at the development of the petrochemical industry, of which the individual part tasks are related closely to the contamination of the macro environment or the protection of the macro environment from contamination. Or let us think of the target program covering light construction methods, which ultimately is aimed at the creation of a satisfactory micro environment. Obviously, many nodal points ("events" — meaning the starting and completion dates of many part tasks) of both programs are necessarily related to many nodal points of CP [Target program] K-5. However, CP K-5 — which is in progress since about six years — does not yet have its own "internal" network plan (no doubt for partly objective reasons) to which we could connect. It is therefore possible that there develop many preliminary research results for which we have no program of utilization in terms of subsequent research (this has actually happened in some instances). Also, a start is made of many part programs which should be based on preceding part programs without this preceding part program being completed, or even started. Obviously, at the present time the importance of the problems caused by this factor is obscured by the fact that many of the part results find direct use, for example in environmental protection, although by far not as effective a use as if it would be part of an integrated complex result from an overall project. To quote an example, the effective utilization of the results of CP K-5 already available on the basis of studies (primarily natural-scientific studies) is also considerably hampered by the backwardness of the social and economic studies which are also part of the overall plan (which is primarily science and technology oriented to be sure). As a matter of fact, these studies, plus the also envisaged administrative-theoretical studies, have not all been even started.

As a result of this state of affairs, we find that the effectiveness of the final results is low, and also that it is difficult to see clearly — let alone to periodically monitor — the overall project with its many facets. Because of these deficiencies, the periodic reports (for example the five-yearly reports) merely list the theme designations and the amount of funds expended on them. This is regarded as satisfactory from the "bookkeeping" point of view. But is is definitely unsatisfactory for determining whether

enough was accomplished with the time and funds expended and how much more is required for the completion of the project. In order to answer questions like this, an analysis of the entire research material of the project would be required, and the committee charged with the supervision of a target program — which may require hundreds or even thousands of themes — can obviously not do this, especially if the fact is realized that the members of the committee have other obligations arising from their primary endeavors.

The laxity of the research system for such complex programs also offers possibilities for "somehow including" the contents of so-called "hobby" projects in the overall theme (broadly interpreted) of a major project being carried out at a research institution involved. (Such "hobby projects" are more difficult to finance than portions of target programs.) The result of all this is that the target programs, and the main directions, eventually become diluted with such "parasites," which in part were also included just to fill up the financial plans of the institution. This is not necessarily deplorable since it offers the possibility of pursuing some potentially useful subjects, for which no present financing is otherwise available, and it also permits the utilization of any existing research capacility that may be unutilized at a given time. But it would also be conceivable that the studies could be more precisely programmed and such existing research capacities could be assigned for more needed activities related to planned projects instead of for "hobby" projects.

Lack of an Overall Concept in Urbanistics

The status of urbanistic studies is even more problematic: in this area we lack any long-range or even medium-range research program. Nor do we have a concept even for this comprehensive subject, so that a network plan is entirely out of sight. As a result, each research theme in this field comes into the operating plans of the institutions concerned as an outcome of "wheeling and dealing" between the principals and the contractor institution. The research institution also has a central (MTA) fund allottment for carrying out valuable "hobby" studies (on a modest scale). In this connection it should be noted that the Urbanistics Committee of the MTA is engaged in examining this subject area, in exploring the deficiencies, and in formulating the measures necessary for dealing with them. The committee, among others, endeavors to prepare a research concept — at least for the medium term — within the shortest possible time. It also looks at a number of problems which are important and urgent for the advancement of the discipline of urbanistics. A non-comprehensive list of such problems includes the relationships of urbanistics on the one hand, and of

social sciences, economic sciences, transportation sciences, and applied mathematics on the other hand, as well as the problems of farmstead settlements, suburban areas, city centers, urban renewal, residential settlements, recreational areas, and the like, both as they exist at the present time and as they may develop in the future. Even this sketchy listing may suffice to illustrate the fact that this discipline is indeed ready for the formulation of a comprehensive program.

The development of a research concept for the discipline of urbanistics is definitely warranted for the additional reason that work is being performed in several research subjects which are related to urbanistics and its associated fields. Some of these run in parallel without coordination with urbanistics, sometimes even without awareness of the fact that there may be a relationship of this kind. The themes are included in such disciplines as geography, economic sciences, sociology, and so forth. If we could coordinate all these themes and subordinate them to a major goal (meaning that we could incorporate them all in a comprehensive network plan), we could obtain much more useful and effective results.

Of course, the above is not to be construed as meaning that we oppose the approach of a problem from various areas and thus from the point of view of various disciplines; what we do mean is that these various approaches should be coordinated so as to achieve optimum development and the search for most effective realization.

Lack of the "Methodology" of Complex Studies

We must say a few words about a phenomenon which today makes practically unsolvable the development of such interdisciplinary programs, the supervision of their performance, their coordination, and the establishment of the desired synthesis. We lack knowledge about ways for the proper preparation of such complex studies and do not know how to carry them out in the proper manner. In other words, we lack the methodology of the "technology" of complex studies on a scientifically proper basis.

Current practice in the preparation of such complex and extensive "research galaxies" is that the organ supervising the subject area solicits suggestions for part themes, which form major groups, from superior organs judged competent for some reason or another or from other sources, based on a thematic system developed with the best intentions (containing a list of the main areas that are judged worthy of study). One should not be surprised to find that each and every organ or other source queried does indeed submit some theme suggestions, partly because it indeed does know of

relevant subjects worthy of exploring (or at least may be made to sound as being part of one of the listed major themes) and partly because in this manner it may become a recipient of part of the funds earmarked for central support for some of its institutions. As a result of the fact that there is no organic cooperation whatsoever among the suggestors, and also of the fact that the titles of the main themes listed (even their annotations) are quite general and may be interpreted in various ways, the suggestions yield a multitude of themes — of which many may indeed be useful and valuable but of which all lack a weighting as to priority or urgency, let alone a proper evaluation in terms of prerequisite-consequence relationships. The program-supervising authority would have to organize the themes according to these considerations , using a network plan for this purpose. The financing of the overall project should also be dependent on such a plan. Instead, however, choices are made on the basis of titles of themes (or even on the basis of the authority of the suggestor) so that we sometimes have parallel activities under financing. In order to "streamline" the cost allocations which became inflated as a result of this, we carry out a so-called "adjustment" procedure according to which we divide the available funds among themes, and allocate just enough for each theme to "get it going" to some degree, independently of whether the starting points of them make sense in a proper network plan or not.

This "paralleleity" principle is also used when the results of the research studies are combined: the "comprehensive summary documentation" consists essentially of the listing of the report summaries of the establishments where the part themes were studied, containing their own conclusions. They are listed rather than summed up in an integrated fashion. The result is that instead of a clear and specific formulation of the problem judged worth studying — and the solution of the problem — we obtain a "pile of answers" which may be useful and interesting in themselves but which should really have been synthesized. But, because of a lack of a better approach, this synthesis is carried out by "brainstorming" usually on the committee level. Although this method is satisfactory for the evaluation of the central problem and of parts of the final report, has the hazard that subjective opinions enter and that the answers that are obtained are inaccurate, vague, or incomplete, even if formulated by outstanding experts.

Summing all this up, we may state that the development of the methodology of research in interdisciplinary target programs is important enough to become a goal of the national-level research themes.

Basic and Advanced Training of New Kinds of Experts

An important part of this area of problems is the basic and advanced training of experts who are competent to organize, manage, coordinate, and synthesize complex studies. As science becomes more and more differentiated, specialists in more and more part science areas and borderline areas become necessary, where these specialists become more and more versed in the details of their specialty and where these specialties become more and more narrow. As the same time, these specialists become less and less able to comprehend the more and more special scientific fields that develop. Limitations of the capacity of the human brain and increases in the amount of knowledge available in each scientific specialty result in the fact that there will be more and more scientists who do not comprehend the vernacular, let alone the subject, of the other scientific specialties. This has already happened in the two interdisciplinary fields mentioned earlier, where we are already close to the "pre-chaotic" state, in which the technicians, economists, sociologists, hygienists, legal experts, administrators, system engineers, and other experts — who are involved and who nominally participate in the overall study — develop such a joint "documentation" where an individual contributor to the overall report — be it a team or an individual scientist — can comprehend only part and comprehend the rest only in general terms, if at all. The team of scientists which ultimately performs the "brainstorming" for synthesis also consists of specialists from various fields, who also have only a sketchy understanding of the terminologies and considerations of the documentation. At the same time, they will exercise suspicion and some condescension in organizing cooperation among various disciplines, and will look with disdain on those who endeavor to create "generalists" since they will regard this as an endeavor toward creating "universal barbarians" who know very little about very much. Of course, there is an increasing need for such "science managers" but in order to have them we must first create the discipline of "science management." This, among others, means the acquisition of the terminologies and general knowledge contents of the individual specialties, as well as such system-engineering and system-theoretical knowledge which would enable the manager to coordinate and objectively evaulate the conclusions and findings of the scientists working in the various special fields.

Lack of a "Host" for Interdisciplinarity

The fact that interdisciplinarity lacks a "host" of some kind creates additional difficulties in research. The Academy of Sciences, sams as any other scientific institution on the national level, still features the characteristics which existed at its foundation, which were then relevant,

or were at best modified a few decades ago. The academic departments established in this manner — which were thus evolved historically — are separated from each other by administrative walls, which are relatively difficult to break through. Representatives of some interdisciplinary fields of science already succeeded in "finding a place under the sun"; however, this was only accomplished by operating in the jurisdiction of a scientific department of which the subject area is at least partly relevant. Within that department, it is quite isolated from the other sciences included in the interdisciplinary field, and this ultimately leads to the departmental narrowing of the field of science concerned.

Urbanistics is one such field of science: it obtained a place in the technical area since technology plays a primary role in the realization of its objectives. No doubt, this helped this acience field to achieve some successes already. However, the unfolding of a combined discipline "officially" classed in a specialist department could be accomplished only as a result of the inclusion of a "relevant" scientist in the department or as a result of occasional invitation of "foreign" scientists, which is a less desirable approach than a systematic and continuous cooperation. In principle, full implementation of overall interdisciplinarity may be best accomplished through the system of target research programs which allow for the inclusion of all departments and scientific institutions involved. But in this case, as we have seen in the field of environmental sciences, we still do not have the proper system organization and synthesis conditions to ensure that interdisciplinarity is effectively implemented and the results are properly utilized.

Another proof of the relative lack of solution of the matter of interdisciplinary studies is the fact that there are parallel studies in related fields within the framework of the target programs; yet, the coordination of these studies would utilize better the funds available for the subject matter and would reduce the need for extensive coordination, which is not performed well in any event.

Although in Hungary the completed studies are recorded and filed according to legally prescribed criteria, it still does happen that studies are initiated which have been already undertaken — with or without success. This has nothing to do with interdisciplinarity. It also happens that such overlapping studies have been carried out in the very same institution, As we all know, it also happens often that we investigate many problems which have already been solved abroad, and for which the solutions are available for purchase as "know-how" or for use under licence. Our scientific information system is still inadequate, but promising initiatives are underway in this field.

But even the most perfect information system — from a technical point of view — cannot function well if the organization of the various themes and part themes is not logical and unified. As we have already mentioned, however, there is complete chaos in our interdisciplinary themes. Let us discuss only a single example: urbanisctics as a discipline is assigned to the Department of Technical Sciences of the Academy; however, at the same time urbanistics is classified at the Library of the Academy of Sciences under its major sub-themes, such as urban redevelopment, village redevelopment, areal redevelopment, "the arts," and so forth. Environmental science is not listed as a classification heading at all, not even under a reasonable other name. This phenomenon, illustrated with two examples, is a general one, not only in Hungary but worldwide. There is an urgent need for the precise definition of interdisciplinary areas in terms of their classification and their relationships with other scientific areas. Of course, the "cleaning up" is not purely a domestic task. It applies everywhere if we are to have a universally accepted and used system. So far, even the listing of the CEMA specialties is not the same consistently, and what general listings there exist do not agree with the Hungarian listing. For example, the sciences related to urbanistics are found in the group of "building sciences and urban construction." But this does not include the field known as "engineering sciences." According to the standard list, environmental science is in the "biology" category, yet this interdisciplinary area encompasses many disciplines ranging from meteorology to legal sciences, and everything else in between.

The final obstacle of the effectiveness of interdisciplinary studies is the "last link in the chain" of scientific research activities, that between the results of research and their utilization. This is usually handled by a unit of a superior organ which is already overtaxed by many other responsibilities — mostly of an administrative character. It may be in the hands of a single person. It is therefore not possible to synthesize logically all the incoming reports and handle their utilization. Also, in view of the many influences coming from the outside and from above, is is preferred to have an interdepartmental government committee make the final decisions here, partly in consideration of the reports (which are not primarily prepared with utilization in mind). We have much still to do to ensure that our practices conform to the worthy results of scientific research.

2542
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ROLE OF SCHOOLS IN SCIENCE DISCUSSED

Budapest TUDOMANYSZERVEZESI TAJEKOZTATO in Hungarian No 18 No 3-4, 1977 pp 380-384

[Article based on the paper of J. Szacki, published in THE POLISH SOCIOLOGICAL BULLETIN (Warsaw) No 1, 1976 pp 15-29: "Schools in Science"; compiled by Mihaly Dalos]

[Text] The Definition of the Scientific School - The Role of the Schools in the Advancement of Science - Are Scientific Schools Desirable?

Few subjects come up so often yet are so poorly defined in the literature dealing with the advancement of science as the term of the so-called "Science School." This area of scientific endeavor has been studied only very little so far, and the views held differ considerably. The different opinions concern the following three groups of questions:

1. How is a science school defined? What grouping of what kind of scientists may be called a scientific school?

2. What is the role of science schools in the advancement of science? Is their role positive or negative? Can the development of science schools be detached from the advance process of science, are these schools just a special step in the developmental process, or are they typical for a special class of discipline(s)?

3. Is it desirable to have science schools for the sake of universal human development and advancement of science?

The Definition of the Science School

Based on the responses to a questionnaire distributed in 1969 by A. B. Gotowski and A. Wallis among Polish university educators and researchers the interpretations of the science school may be classed into two major groups. (The question asked on the questionnaire was the following: "Do you regard yourself as a member of a science school? If your answer is in the affirmative, describe how this relationship has started (during your university years, during your work with other scientists, or in the course of a research project)").

According to one group, the development of science schools is attributable to scientific heritage, traditions, and the like; according to another group, it is attributable to the organizational and structural features of the scientific life. Reference to traditions could ultimately be traced back to methods embodying these traditions, so that the science school based on traditions could be regarded as a special case of the so-called structure school.

The so-called structural interpretation of the science school is the most widespread among the researchers. According to this interpretation, the science school is a group of such persons who work together toward the solution of a certain problem. Also, the members of this group represent a defined theoretical or methodological trend; they are in mutual contact, and they recognize the competence of the same persons. Also, they carry out their research according to basically the same principles. In this case, the presence of a "master" is not of paramount importance, although every school has a few members who are esteemed higher than the others. In addition, each school has some so-called front-runners to whom reference is made.

In another approach, the term of science school may be elucidated by the exploration of the formation of science schools. According to a generally accepted view, different scientific opinions play the most important role in the formation of science schools. One should therefore explore first these different opinions, since common differences of opinion are almost commonplace in science whereas science schools develop only very infrequently. Presumably, science schools can form if the differences of opinion involve concepts which cannot be dismissed according to the latest stand of the science but at the same cannot be identified in a clear-cut manner according to the standards of the discipline at the given time. Thus, the new theory is the "property" of the scientist who developed it for a period. But this still does not explain adequately the formation of

a science school. An additional factor is needed for this. The new hypothesis must be related to other theories accepted in the branch of science concerned in a specific manner, and must also affect the studies underway in the given area.

Examining the subject from another point of view, we find that we cannot call a science school by the same definition as a special field of the science branch concerned, meaning that the formation of a science school is not a manifestation of scientific division of labor. Of course, such division of labor may contribute toward the development of a science school (and the reverse is also true). Basically, we can speak of a science school only if the followers of the school regard themselves as in a community with all practitioners of the science branch in certain situations, but identify themselves only with parts of it in other situations. This latter attitude cannot become exclusive since if this were so, we would have not a new school but a new scientific discipline.

As a result of the fact that the science school represents a specific set of opinions, it may be regarded as a social pheonmeon. The science schools create difficulties if we are to examine their problems, partly because we must take into consideration the social interactions, and partly because we must consider the system of opinions and principles.

We are not yet knowledgeable enough to decide the role played by social and phenomenological factors in the formation of a science school. This means that we may not assume that the formation of a science school necessarily means that there must be some original discovery. Sometimes it seems that an influential and organizatorially talented individual may suffice for this.

Accordingly, we conclude that the following factors play the most important role in the formation of a science school:

1. A set of opinions which is not accepted by all practitioners of the science branch concerned.

2. The existence of a group of scientists in the branch concerned to whom the above set opinions is attractive.

Basically, the science school is not an officially established scientific organization. But the science schools do endeavor to establish relations with the official bodies, and try to obtain support from them so as to be able to influence the younger generation. But the official bodies do not require the so-called science schools since they regard themselves as the embodiment of the science branch as a whole.

Accordingly, the following question arises: are science schools the necessary attributes of scientific advancement, or do they indicate merely the bureaucratization of the science and the official organs of the science? Today, only those scientists have the opportunity to establish a science school who have both the scientific disposition and the necessary social and power base.

The Role of the Schools in the Advancement of Science

We find serious differences of opinion not only regarding the concept of the science school but also regarding its role in scientific life. According to the above considerations, some scientists regard themselves as members of a science school, and other scientists reject any such affiliation. Those in the latter category usually reject a science school since in their opinion only a few science schools deserve serious consideration. Most of those who studied this problem believe that the existence of science schools is an impediment, rather than a help, of the advancement of science. Each so-called science school has some inherent hazards for the advancement of science by virtue of the fact that its primary endeavor is to maintain the integrity of the tenets that form the basis of its existence. As a result, its approach becomes rigid in holding to its — real or imagined — theories, and it tends to replace further studies by dogmatic declarations. Those who condemn the science schools do not take issue with the faults of the individual science schools but with the concept of the science school itself. If a researcher regards himself as a member of a science school, he has split loyalties: he has a loyalty to his own group and to the practitioners of the given science branch as a whole. In the case of a conflict, the former loyalty usually predominates. Thus, the value-measuring standards may reverse in the case of each science school; the social cooperation of the scientists will not be based on their opinions but, quite to the contrary, on social intertwinings.

However, the above factors can be generalized only if we assume that each science school is a malevolent grouping, the manifestation of a false doctrine. If we assume this, we must also assume that this "false doctrine" characterizes only the science schools, and that they are not part of the advancement of science as a shole. But this would mean a wide idealization of scientific advancement, which is an unacceptable thesis.

It is for this reason that the views according to which science schools play a negative role in the advancement of science are more and more questioned.

An examination of this problem from a novel point of view has been made by Th. S. Kuhn, who wrote the book entitled "The Structure of Scientific Revolutions" (Edition 2, published in Chicago, 1970). Although the ultimate conclusion of Kuhn is not much different from what we said above, the book looks at the problem from an entirely different angle.

1. A basic tenet of the theory of Kuhn is that he objects to the examination of the individual scientific theories according to a so-called universal yardstick, since this method examines the elements concerned out of context.

2. Kuhn doubts the myth that advancement of science is continuous and unbroken. In his opinion, not a single era can accommodate all scientific discoveries made during the era; it can accommmodate only those which were "foreseeable" during the era. Discoveries not complying with this definition create conflicts, which ultimately may start a new era in the science branch concerned.

3. Kuhn also questions continuous criticism and the direct relationship between facts in science. He attributes a greater importance to the role of dogma in advancement in science.

4. The typical feature of the approach of Kuhn is that he regards the examination of the social problems of advancement in science more important than the examination of conventional science history and philosophy. According to him, advancement cannot be understood really if the special features of the researchers, who cultivate the science, are disregarded.

It therefore appears that the conclusion according to which the formation of science schools is a normal phenomenon in the advancement of science, and that the various faults of the science schools described by critics do not differ from the faults of other similar phenomena, appears to be justified.

Indeed, it is important that we remove all emotional, subjective, and inappropriate factors from the evaluation of the science schools, and that we elucidate those conditions which are conducive to the formation of science schools. In this article, we must restrict ourselves only to a few general theories, which basically concern two problems:

a. What is the state of development in a science branch at which science schools can form?

b. What are those science branches in which the scientists are likely to group themselves into competing schools?

If we accept the generally held view that the formation of science schools characterizes primarily the beginning stages of a science branch, then all the above problems become simpler and can be combined into a single conclusion: we must look at those science branches which are still in the state of infancy. In fact, however, we deal with two different problems.

The view held by Kuhn, that the formation of a science school in a given science branch is related to a conflict in the branch, seems to make sense. We must theorefore accept the fact that science schools may form in all stages of the development of a science branch, as soon as conflicts begin to arise in the branch concerned.

Insofar as the second relationship is concerned, it is a stereotype view that science schools form primarily in branches of the human and social sciences. Similar phenomena in the field of natural sciences are usually regarded as manifestations of the division of scientific work. The primary reason for this is that in the latter category the science schools that form are related to differences of opinion and unsolved problems in the science branch concerned, whereas in the former category non-scientific factors play an important role also. There, schools may form which serve only the enlistment of laymen to the tenets of the school (see "Scientific Schools in Hungary. Zoltan Kodaly and His Disciples" Budapest, 1970, 3 pp; paper presented at the VIIth World Congress on Sociology, 1970). This is the reason why science schools form more often in applied science branches than in fundamental science branches.

Are Science Schools Desirable?

On the basis of the foregoing it seems that this is a wrong question to ask since it suggests that a science policy could be formulated about science schools. Yet, we deal with spontaneous processes which are largely inseparable from the advancement of science as a whole. The science schools form irrespectively of the policies devised for dealing with them, and they are regarded as schools usually much later than they have actually been formed. The typical situation is usually that a scientist proposes a new program or theory for the science branch as a whole, and that this becomes a school only by virtue of the fact that the program or theory is not universally accepted. But there is a need for new thoughts in science, and the social manifestations of these new thoughts do not depend directly on their originators.

The practical problem facing us may thus be formulated as follows: In establishing the official structure of scientific life, we must take the possibility of the formation of science schools into consideration. But do these schools require some special patronage or should this specific scientific phenomenon be left to the initiative of the individual scientists? The problem becomes more acute due to the fact that the independence and self-sufficiency of the researchers becomes more and more narrowed as research work becomes more and more expensive. The problem is important since it may turn out that what we have always regarded as an evidence of advancement in science is really nothing more than the consequence of bureaucratization which hampers all types of spontaneous scientfic initiative.

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